THE

AMERICAN DYER,

A PRACTICAL TREATISE ON THE

COLORING OF WOOL, COTTON, YARN, AND CLOTH.

IN THREE PARTS.

PART FIRST GIVES A DESCRIPTIVE ACCOUNT OF THE DYE STUFFS; IF OF VEGETABLE ORIGIN, WHERE PRODUCED, HOW CULTIVATED, AND HOW PREPARED FOR USE; IF CHEMICAL, THEIR COMPOSITION, SPECIFIC GRAVITIES, AND GENERAL ADAPTABILITY, HOW ADULTERATED, AND HOW TO DETECT THE ADULTERATIONS, ETC.

Part Second is devoted to the Coloring of Wool, giving recipes for one hundred and twenty-nine different colors or shades, and is supplied with sixty colored samples of Wool.

PART THIRD IS DEVOTED TO THE COLORING OF RAW COTTON OR COTTON WASTE, FOR MIXING WITH WOOL COLORS IN THE MANUFACTURE OF ALL KINDS OF FABRICS, GIVES RECIPES FOR THIRTY-EIGHT DIFFERENT COLORS OR SHADES, AND IS SUPPLIED WITH TWENTY-FOUR COLORED SAMPLES OF COTTON WASTE. ALSO, RECIPES FOR COLORING BEAVERS, DOESKINS, AND FLANNELS, WITH REMARKS UPON ANILINES, GIVING RECIPES FOR FIFTEEN DIFFERENT COLORS OR SHADES, AND NINE SAMPLES OF ANILINE COLORS THAT WILL STAND BOTH THE FULLING AND SCOURING PROCESS. ALSO, RECIPES FOR ANILINE COLORS ON

COTTON THREAD, AND RECIPES FOR COMMON COLORS ON COTTON YARNS.

EMBRACING IN ALL OVER 200 RECIPES FOR COLORS AND SHADES, AND NINETY-FOUR SAMPLES OF COLORED WOOL AND COTTON WASTE, ETC.

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Introduction.

IN publishing this book I have no doubt but there will be some dyers who will stigmatize me as an unprincipled scoundrel for giving to the world at large what they call the *secrets* of the trade. I will say to such that the time has gone by when every one who was engaged in the art of dyeing thought it was his imperative duty to keep everything connected with his trade as a *secret*, this was an idea that universally prevailed among dyers; within a few years however, those connected in the pursuit of this branch of industry find that it is for their interest to make themselves familiar with every one engaged in the same pursuit and to freely converse and exchange opinions upon those subjects in which they are most interested.

This familiarity among dyers has called forth other means for supplying the demand for information so as to enable those not directly located in manufacturing centers to keep pace with the improvements and new methods of dyeing, and to supply this demand for information, books and papers are printed, which are freely read and are well supported.

But among the many volumes of books on dyeing in circulation, there are at present none that can be called complete, as they give merely a recipe for a few pounds of wool or cotton instead of a kettle full, or the usual amount of wool colored at a time in all dye houses, so that the person performing the operation if not well acquainted (or a skillful dyer) with the qualities and amount of coloring matter contained in the drugs and dyestuff they have to use, cannot use them economically and in most cases cannot produce the color or shade desired.

In this work I have endeavored to give all the necessary information as to the coloring principles, their derivation, their adaptability and proper application, and it is strictly speaking a practical work upon the art of dyeing.

If there are any dyers who wish to obtain more extended information, or fuller explanations upon the dyestuffs than what is found in this book they should consult such works as those of Bancroft, Parks, Berzelius, Berthollett, Chevreul, Thompson, Napier and others which will repay them well for the time expended in perusing them.

The reader in perusing this book will find some quotations from the above named eminent chemists as well as from my father's works.

To these eminent men dyers are greatly indebted; they have given us a correct explanation of the chemical changes that take place in the different processes of dyeing, their skillful and laborious investigations have been very beneficial to dyers in pointing out to them the necessity of a chemical knowledge of the first principles of the art of making artificial colors, (or dyeing,) for if there is one art more than another that requires such a knowledge it is that of dyeing, for it is of the utmost importance for a dyer to understand chemistry, at least that part of it that is connected with his trade, for without this chemical knowledge dyeing cannot be either profitably or economically followed, as it depends entirely upon chemistry for its full development and successful practice. I have not written this book with the intention that every one who will purchase it, and who understands the manual of operations in a dye house can be made a skillful dyer by the perusal of it, and every intelligent dyer will exonerate me from harboring such an idea.

If there should be any one that purchases this book who wishes for any explanations in relation to the recipes or instructions given therein it will be cheerfully given by addressing the author,

RICHARD H. GIBSON.

MOHEGAN, Providence Co., R. I.

The American Dyer.

PART FIRST.

THE NATURE OF COLORS.

STRICTLY speaking, colors have no existence, but are the effect of light, or at least colors do not exist in the objects that appear to be colored, but in the light which is reflected from the apparently colored object.

To define color we will briefly state what is known upon the nature and composition of light.

"A beam of light is composed of three distinct colored rays, red, blue and yellow. When a beam of light strikes the surface of a body it bounds off as an elastic ball would do in striking the same surface, and this bounding off is called reflection, or it is absorbed by the body and disappears and is altogether extinguished, or it passes through the body, making it transparent."

The bounding or reflecting rays pass into the eye, and the article or substance from which it is reflected appears white or some particular color. No light can proceed from the object to the eye, it being absorbed and extinguished, the body therefore will be invisible, or, if the surrounding objects reflect light the article or substance appears black, but if the light passes through unaltered, it will appear clear. Thus what is custom to call white light is the simultaneous

transmission of three colored rays. "For instance you admit light into a dark room through a small hole in a window shutter, and opposite to it on the wall of the room, place a piece of white paper so that the light passing through the hole will strike upon the paper, you will see that the light is decomposed and will appear upon the paper in the following order:"

Violet,	*Green,*	*Orange,*
Indigo,	*Yellow,* *	*Red,* *
	Blue. *	

These are called the seven prismatic colors, those that are marked * are the simple or primary colors, that is they require no admixture, but the others are a mixture of two different colors, the orange of the red and yellow, the green of the blue and yellow, the indigo of blue and red and so is the violet. Color is the result of the abstraction of the celestial hues from the solar beams by the affinity of the coloring matter (or principle) for it, and the coloring matter coming in contact with metallic oxides the different hues or colors are fully developed and shown to the human eye as they are from a prism, and all the colors whether they are artificial or natural, or on whatever seen, has once been a beam of light in the heavens and the impregnation of the coloring matter, with a ray of light, and then being by it transferred to an oxide, which then reflects it upon the eye, constitutes the whole philosophy of colors and the dyer when engaged in his profession is performing the operation of transfusing celestial hues through terrestrial substances; he is imbuing material substance with the immateriality of light.

As every chemical change affects the character of the substance in its relation to light, the dyer's object is to cause a combination with the wool or other textile fabrics that will produce certain effects upon light and thereby produce different colors or shades. The experiment goes to show how much the production of colors depend upon the relation of the substance to light. "We will take a solution of iodide

of potassium which is colorless and transparent, and divide it into three equal proportions; into the one we will pour a little sugar of lead (acetate of lead), into the other a persalt of mercury, and in the third a little starch and a few drops of nitric acid, these are all colorless substances when in solution of themselves; in the first we will have a yellow, in the second a red, in the third a blue." Here we have got the three primary colors produced by the same substance combined with other substances which was previously colorless.

A color consists of parts or substances only, and combining these substances or materials in the best manner, and fastening it permanently upon different fabrics, and with a knowledge of the chemical laws on which these effects are based or founded, is what constitutes the skill of the dyer.

THE RELATION OF COLORS TO THE ART OF DYEING.

Colors considered in relation to dyeing are of three kinds, the insoluble, the partly soluble, and the liquid. The insoluble will only unite to a fabric by virtue of the affinities which its component parts have when separate, for the fabric and for each other, the insoluble is the most permanent kind of color. To illustrate this let us mix two clear solutions, one of the solutions we will make with some kind of coloring matter and the other solution from an earthy or metallic salt; mix the two solutions together and the substance that will be held in solution, passes from the liquid to the solid state; in some cases this change will be almost instantaneous and the solid result will rapidly fall to the bottom of the vessel as an insoluble powder, after a short time you will see that a separation has taken place, and that a curd-like matter has settled to the bottom in a loose, flocky state, and the least moving of the solution will cause it to rise again in the supernatent liquor. But as the component parts of this in-

soluble color, have each when separate, a strong affinity to combine with vegetable and animal tissues, and likewise with each other, the process of coloring is effected by first mordanting or impregnating the fabric with the chemical salt and then passing it through a solution of some kind of coloring matter.

We find that the perfectly insoluble colors are mostly mineral and that their specific gravities are much greater than those that are obtained from vegetable dyestuffs, or the partly soluble colors. The colors thatare the most insoluble are those whose constituents are brought together by an attraction so powerful as to neutralize the affinities that produced it and when the metal in the compound exists in a highly oxydised state and the coloring principle joined with it shows the character of an acid. The properties of an insoluble color have all to be transferred to the partly soluble one, in order that it may possess the utmost degree of permanence of which it is susceptible, the addition of a third substance, capable of giving these qualities to it, becomes absolutely necessary in the composition of colors for wool or woolen fabrics. The substance that we must employ for this purpose should have the power of combining with the color and the substance to be colored and should have a great inclination to form a solid combination with them. This combining power is contained in the bitartrate of potash in a very great degree, it also divides minutely the particles of coloring matter and softens the action of the mordants upon the wool, and for this reason there is so great a use made of tartar on such colors as are made at one operation in woolen dyeing.

All salts that contain an excess of acid are better to form ingredients in the mordant of a color, than their respective acids when in a free and more soluble state, and out of the whole number, tartar is the best adapted to answer this purpose for woolen dyeing. Those colors with the greatest specific gravities are those that contain the most infinite particles and in consequence of this they possess the greatest

intensity and vivacity they are also the most insoluble and for that reason they are the most permanent, they are those colors in whose composition an acid enters either as a modifier of the color or as the coloring principle. They are what is termed mineral colors or colors that are made to approach to the nature of mineral colors by the addition of an acid salt which we find has greatly increased their particles and produced the insoluble state in them.

The partly soluble colors are those employed for woolen and calico printing; all the materials that compose the color are all mixed together and are then applied at once by the block or machine and then fixed by the steaming process. The liquid color is only a modification of the other kinds, which is rendered more soluble by the assistance of an acid or alkaline menstruum which acting as a medium of solubility, exercises so great an action upon it as to change its nature and to destroy its durability, and it will very easily combine with the fabric, but it is very fugitive.

We have shown that if a metallic or earthy solution was poured into a solution of coloring matter that it will immediately precipitate, forming a curd-like substance at the bottom of the vessel, of more or less insolubility; to this precipitate we give the name of color, and the knowledge of making and combining it with wool, silk, and cotton or manufactured fabrics we call the art of dyeing. This precipitate will again become soluble in the solution from which it was formed, by boiling the solution, and will combine with the wool or fabric, while in a state of solubility, and after the wool has been brought to a particular depth of shade, should we continue the boiling the color is seen to grow poorer, or we may say the color boils off. The cause of this is, the coloring matter is in excess of the mordant, causing a reaction to take place, the coloring matter has begun to re-dissolve the precipitate that was formed and had fixed itself upon the fabric; to remedy this we have to give it more mordant by saddening with such metallic or earthy salts as the particular color or shade requires. This boiling off of the color is very noticeable in

coloring scarlet, but more especially in coloring black on cotton, when after the color is brought up rich and full, (if the coloring matter in the dyeing bath is in excess of the mordant upon the cotton required to take up all the coloring matter,) it will begin to grow paler the longer you leave it in the liquor, and finally it comes down to a slate color instead of being a black.

This proves that when the coloring matter is in excess it has the property of dissolving its own insoluble precipitate. This shows the necessity of the dyer exercising a great amount of care and judgment in proportioning the mordants and dyestuffs in relative quantities, in order that they may saturate each other without having either of them in the bath as a useless superfluity, but if either of them are allowed to exceed the other let it be the mordant. But to obviate this boiling off as it is termed, whenever the wool has been brought up to the desired shade, draw off the tub or kettle, for fear of the color changing by too long an exposure to the action of the coloring solution.

HARMONIZING OF COLORS.

There is too little attention paid to the harmonizing of colors by designers and superintendents of woolen mills. Upon this subject there was a great proposition made for the decoration and laying out the manufactures of the Exhibition of 1851. I will quote from the *Athenæum* some passages that will be useful and beneficial to most designers and superintendents. "It has long been known that if you look steadfastly for a few minutes on a red surface fixed upon a white sheet of paper, and then carry your eye to another white sheet, you will perceive on it not a red but a green one; if it is a green the other will be a red; if purple, the other will be yellow; if blue the other will be an orange.

"When two colored surfaces are in juxtaposition they will mutually influence each other, favorably, if harmonizing

colors, or in the contrary manner if discordant and in such proportion in either case as to be in exact ratio with the quantity of complimentary color which is generated in our eye.

"For example if two half sheets of tinted paper, one dark green and the other red, are placed side by side on a piece of gray cloth the colors will mutually improve in consequence of the green generated by the red surface adding itself to the green of the juxtaposed surface thus increasing its intensity, the green in its turn augmenting the red.

"It is not sufficient to place complimentary colors side by side to produce harmony of color, their respective intensities have a decided influence." A pink and a light green will agree, a red and dark green agree, but you will find that a dark pink and dark green will not, neither will a dark red and light green agree.

To obtain harmony and effect perfectly, we must put the following colors side by side :

Red and Green. *Blue and Orange.*
Yellow Orange and Indigo Color.
Greenish Yellow or Sulphur Yellow and Violet.
Black and White.

These colors embrace all, as we have the primary and secondary colors, and if the colors are not arranged as above, instead of colors improving each other, they will lose both in beauty and intensity. "If blue and purple are placed side by side, the blue throwing its complimentary color, orange, upon the purple, will give it a faded appearance, and the blue receiving the orange yellow of the purple, will assume a greenish tinge.

"The same may be said of the yellow and red if placed in juxtaposition, the red by throwing its complimentary color, green, on the yellow will communicate to it a greenish tinge ; the yellow by throwing its purple hue, imparts to the red a disagreeable purple appearance.

" It is of very great importance that every one should be acquainted with the laws of colors who intends to display or arrange colored goods or fabrics." And if there is one person more than another that is interested in the manufacture of textile fabrics, composed of a variety of colors, who should fully understand the laws of colors, it should be the designer, for to the harmony of the colors is the beauty of the fabric mostly indebted.

WATER.

The original source of water is from the surface of the ocean, it is vaporized and carried through the atmosphere in clouds and falls upon the earth as dew or rain. Rain water is the purest unless near cities or large towns where it dissolves matters in the atmosphere, such as ammonia and carbonic acid; when rain water strikes the earth it becomes impregnated with the solid matters of the soil through which it has to pass, and these ingredients or matters cause the different effects which is experienced by dyers in using different kinds of water. The impurities depend altogether upon the source of the water, that is from the nature of the soil through which it passes, and these impurities will act and react upon the dyestuffs used, so it is very necessary that the dyer should fully understand the nature and effects of the water he will have to use. Water as a general thing is called hard or soft, it may be soft and yet not as good as hard water for coloring purposes, and it may be hard and be good for dyeing almost every color, but the term hard or soft does not denote any particular kind of impurities it may contain. The substances in water that are the most deleterious for dyeing purposes are lime, magnesia, potash, iron and copper. Water contains other substances besides the above, but they do not affect the dyestuffs to any amount. If the water is hard it contains carbonate of lime or carbonate of

iron and sulphate of lime; if soft it contains alkalies, such as soda, potash and ammonia.

Water that contains carbonate of lime in solution may be detected by boiling the water, which will decompose the lime and it will settle at the bottom; the sulphate of lime will have a less precipitate after boiling than the carbonate of lime.

Iron may be detected by adding a few drops of gallic acid to the boiling water, it will turn black or blueish if it contains iron. Another way to detect the presence of lime in water is to add a few drops of oxalate of ammonia to the water and if lime is present there will be a white precipitate formed at the bottom, the same as that formed after the boiling experiment; by adding a few drops of phosphate of soda to water and stir it for a while then let it settle and if it contains magnesia there will be a whitish precipitate formed at the bottom.

The following tests for water I have taken from Park's Chemical Essays, a work well worth perusal by all dyers.

TESTS USED	AND	WHAT THEY WILL DETECT.
Oxalates or Oxalic Acid,	-	*Lime.*
Litmus,	- - - -	*Uncombined Acids.*
Tumeric Paper,	- - -	*Alkalies and Alkaline Earths.*
Chloride of Platinum in alcohol,		*Potash.*
Polished Iron or Steel,	-	*Copper (with precipitates.)*
Phosphate of Soda,	- -	*Magnesia.*

The substances enumerated above are sometimes so minute that the common tests do not always detect them.

The following method of testing water is recommended by Fresquet. Try the water with prepared test papers and observe if it has any acid or alkaline re-action, then boil a gallon down to a pint, put it in a jar and let it settle for a while, pour off the clear liquor into another vessel and keep

the turbid remainder for examination. The insoluble precipitate, if any, will undoubtedly be carbonate and sulphate of lime and a trace of iron; carbonate of lime is held in solution as bi-carbonate. but the boiling decomposes this compound, one proportion of carbonic acid being given off and the insoluble carbonate precipitates. "The sulphate of lime is soluble only in a small quantity, and a little is precipitated by boiling.

"To the precipitate add a few drops of muriatic acid and the carbonate of lime and iron will dissolve with effervescence, while the sulphate of lime will remain in an undissolved state. A few drops of Tannic or gallic acid added to a portion of the pint of water will turn it a blueish color.

"A portion of the above solution may be taken, and a little ammonia added to neutralize the muriatic acid: if lime is present the addition of a little oxalate of ammonia will give a white precipitate. The water that is boiled down to a pint is now taken and divided into five portions and put into small test glasses, to one portion add gallic acid, if iron is present the solution will be black or blueish. To the second portion add a few drops of oxalate of ammonia to detect lime. To the third portion add a little phosphate of soda and stir it up well, if there is magnesia there will be a white sediment. To the fourth portion add chloride of barium and if a white precipitate is obtained that does not re-dissolve by adding a little nitric acid to it, then the water contains sulphuric acid. To the fifth portion add nitrate of silver, if a white precipitate is formed and does not re-dissolve by the addition of nitric acid, then the water contains muriatic acid."

These tests and the nitric acid used must be perfectly pure or no dependence can be placed upon the results. The best water that I ever used for coloring blacks and other dark, heavy, saddened colors, I found by analysis to contain sulphuric, muriatic and carbonic acids, lime, and a trace of iron, this was the water used by the Lawrenceburgh Woolen Mills, at Lawrenceburgh, Indiana, and I think that most of the water used in the West contains the above substances.

MANUAL OF OPERATIONS IN THE DYEHOUSE.

Every dyer having his own particular method or way of doing work in the dyehouse, what I may say in regard to the operations will be of no account, yet I should not feel as if this work was complete unless there was something said upon the manipulations of the dyehouse. In the first place have the wool scoured clean (see article, wool scouring,) the day before it is to be colored so that it may drain well and evenly, then shake it up loosely in front of the tub in which it is to be dyed, pulling apart all the hard and twisted lumps so that it can take the color evenly when it is thrown into the tub or vat; leave the tub low enough with water so that after the dyestuffs have boiled the proper length of time you can run in water enough to cool it down to about 170 or 150° Fahrenheit (at which heat I think it is best to begin coloring any color, and if on cloth at a lower temperature than that,) then throw in the wool, loosely, expeditiously get in the poles and handle it well for ten or fifteen minutes, turn on the steam and bring it to a boil as soon as possible which continue for one hour or one hour and a half, or as the recipes specify; do not boil the wool too hard but give it steam enough to keep it just on the spring of the boil only; after it has boiled three-quarters of an hour, put the poles in again and pole it enough to change the position of the wool a little which will prevent it from stringing or twisting. If the color is one that requires saddening, put such chemical salts as you intend to sadden with into a barrel or some convenient vessel, put some of the liquor from the dyetub into it to dissolve them, throw it on slowly and a little at a time, while the men are poleing it up. I think this is a better plan than to throw it on in the solid state, as you will get it on more even by having the salts in solution.

In making colors that are prepared (or when the mordant is put on before the coloring principle,) they should be prepared in the afternoon so that it may have time to lay in the preparation liquor; it is more important that the wool should

lay in the preparation liquor a longer time than in the coloring matter. It was in times gone by, the universal practice to wash the wool after it was prepared, before entering it into the dyeing bath, but I do not think it necessary; that which is at the bottom of the tub should be extracted or placed upon a scray to drain while the dyestuffs are being boiled out, then it should be shook up again the same as for the first process. After the wool is colored it should be washed off in the rinse box, (if it is possible to do so,) but do not let it roll around in the box much as it strings or felts it. There are no rules without some exceptions, therefore any variations from the plans generally adopted in dye houses you will find specified in the recipes requiring such deviations.

ON THE TREATMENT OF THE DYESTUFFS IN THE DYE TUBS.

The dyestuffs come to the dyer either in a chipped or ground condition, and the economy of dyeing depends upon the treatment they receive to extract all the coloring matter from them, and to do that you should in the first place after your tubs or kettles are emptied see that they are cleaned out and washed, in order that no remains of the former dye is left in it, as any portion of the metallic salts, alum, &c., have a tendency to prevent the coloring matter of the dyestuffs being extracted, and especially from the hard resinous woods, such as Camwood, Barwood, Saunders, &c., which refuse to give out all their color, if ever so little of these salts are in solution in the liquor. Next use the coarsest bagging you can get, (hair bagging is the best,) for boiling out the chipped dyestuffs; do not put too much into them, nor have them tied too far from the end, but leave all the space you can so that the inclosed chips can change their position by the boil, or the stirring up that you will once in a while give the bags; suspend the bags on a stick laid across

the dye tub. If you have a color that should require nothing but ground dyestuffs, boil them out in a separate vessel, (a barrel for instance,) and take the clear solution and put into the dyeing tub ; half a hour's boiling is sufficient for the ground dyestuffs ; should you not have the convenience for boiling them out, then throw them into the dye tub loose, but do not put them into bags, because they will be so solid and compact in the bags that it will be almost an impossibility to extract the coloring matter from them.

If you are making a dye that requires both chipped and ground dyestuffs you can then mix them together and boil them in bags, but in this case it will take more of the ground dyestuffs than it would if they were thrown loose into the tub ; by mixing the ground with the chipped, or boiling out as above, you have the advantage of your wool being clean and free from dust.

I have sometimes sprinkled on the ground dyestuff upon the wool before entering it into the dye tub ; you can adopt either of the above plans, but I prefer the boiling out plan before entering the wool. The right plan is never to have any loose dyestuffs in the tub (as it gets amongst the wool and fills up the cards, and will not card or spin as well as it would if they were kept out). Let the coloring solutions, in every case be clear aqueous tinctures of the coloring principles only.

If you should have a color that is done by one operation, that is, a color that requires the coloring matter and the mordant, to be all in one bath, you will boil out the dyestuffs as above, then dissolve the chemical salts in a pail, and pour it into the liquor, then heave in the wool. Lastly, in preparation colors, when the chemical salts are employed as the mordant, all you need do is to dissolve them in a pail or throw them into the tub and boil until you think they are dissolved. Any variation from this plan you will find stated in the recipe requiring it. One hour and a half boiling is all that is required for the chipped dyestuffs but if you have ground and chipped mixed in the bags, then boil them two hours.

THE DIFFERENT PROCESSES OF DYEING.

There are but three general processes of combining color to wool or woolen fabrics. The first method or process is by applying the whole color at one operation. Let us illustrate or explain this process.

"If into a clear solution of fustic, logwood or other kind of dyestuff, you should pour another solution of some metallic or earthy salt, such as proto sulphate of iron, for instance, you will see that when the mixture takes place, the solution becomes broken and that a curd-like matter is formed and settles to the bottom of the vessel that contains the mixture. This is the precipitate or color which is the first mode of dyeing you apply to wool.

"This experiment exhibits the formation of any color we wish to combine with wool, showing to the visual organs the mysterious operations of the mechanism of dyeing, for we really see the union take place between the coloring principle and the metallic or earthy salt; the combination of the two substances forms the color we wish to apply to the wool or cloth.

"Although this curd-like substance or precipitate (which is color) will slowly subside to the bottom, and leave the solution but slightly tinged, for all that it is not an insoluble precipitate, but is partially soluble at a boiling heat, and on this slight degree of solubility rests the property it possesses of forming a chemical union with the wool; but if it formed an insoluble precipitate, no chemical combination would take place by this mode of dyeing, because the wool or cloth being boiled in a solution containing nothing but an insoluble powder, no chemical action could take place between them, and the article would be only just stained, and this insoluble precipitate would adhere to it with but a slight mechanical force, and by simply washing the article thus stained would remove all the color it imbibed."

But this partial solubility of the color is the cause of its union with the wool, for if the wool is immersed in the liquor

it will immediately seize the part held in solution, (the affinity between the color and wool being greater than between the color and the water,) the water thus robbed of what it held in solution, now dissolves more of the color which will be again taken up by the wool, and so on portion after portion until the whole becomes combined with the wool or cloth. "This mode of dyeing requires stronger boiling during the time of coloring than either of the other processes, as the greater the heat and agitation given to the water, the more are the broad flocky particles broken and cut up, and in proportion to the fineness of the coloring molecules so will be the intensity of the shade."

This method of dyeing is more expeditious than either of the other two, but it is not equal to them in permanency or brilliancy of color.

This method of dyeing is used mostly for yarns, flannels, and cloth, especially the finer colors, and you will find it used on some colors in the recipes for colors in this book.

SECOND PROCESS.

This mode of dyeing is known among dyers as stuffing and saddening. After the dyestuffs are boiled out, the wool is entered into the solution and boiled one and a half or two hours, this is termed the stuffing part of the operation, and the wool will receive a slight tinge of the color peculiar to the dyestuff used in making the solution. Longer time than the above in boiling is needless, as all the color that is required to produce the best effect is, in that time, combined with the wool. Next comes the operation of saddening or giving it the mordant, which is some chemical salt, such as copperas, blue vitrol, alum, &c., which some dyers throw upon the wool in the solid or crystalized state (while the men are poleing up the wool,) others dissolve the mordant or saddening in a barrel, and then throw it on with a dish or pail, this latter plan is the best in my opinion. In the first part of this

process, a combination is effected between the wool and the coloring matter of the particular dyestuff used.

" In the saddening part of the process, both the coloring matter and the wool having a strong affinity for the metallic or earthy salts, these are drawn by them with an increased attraction, and a triple compound of animal matter, the coloring principle, and the mineral base of the color is formed; which being held together by virtue of the three separate forces, offers so strong a resistance that boiling water cannot disunite them." "Precisely similar are the various unions of the coloring matter with wool, no matter what process you may employ to effect it."

THE THIRD PROCESS.

" This consists of two distinct operations which are termed preparing and finishing; the first operation is to boil the wool in a solution of the metallic or earthy salts (that form the base of the color we want to produce,) for one hour and a half; this mordant having such a strong tendency to unite with the wool, that upon coming out of the preparation liquor it is slightly tinged with the shade peculiar to the oxide of the metal you have used, and so strong are its powers of adhesion, that after the coloring matter originally used shall have faded off the fabric, or undergone a material change, the base or mordant is still unaltered, for it will take up coloring matter as quick as before, upon being immersed in a solution of coloring matter."

" The second part of this process consists in boiling up a certain amount of dyestuffs in a bath of clean water until all the coloring matter is extracted; in this the mordanted wool is thrown and boiled for one or one and a half hours. In this case, the wool and the mordant both having an affinity for the coloring matter, their joint forces attract it from the water with such impetuosity that it is at once united with them and the color is soon brought out." Colors dyed

by this process are more superb, brilliant, and permanent than by either of the other two processes, and I advise this plan to be adopted on all colors (with but few exceptions) in preference to stuffing and saddening; it costs but little more and you have so much better colors that I think it pays for all the extra trouble and expense.

From the above observations it appears plain that there can be only three ways of combining colors with wool.

"1st. By applying all the color at one operation.

2d. By combining the coloring matter with the wool and then giving it the mordant.

3d. By fixing the mordant upon the wool first, and then applying the coloring matter afterwards."

ANNOTTO.

This shrub was originally a native plant of South America, but is now cultivated in St. Domingo and the East Indies. It is called by botanists *bixa orellana*, and grows to the height of eight or ten feet, and never exceeds twelve feet. The leaves are a reddish brown color, about four inches long. The stems of the leaves are made into ropes by the natives.

"The tree produces oblong bristled pods, resembling those of a chestnut At first they are a beautiful rose color, but, as they ripen, change to a dark brown, and bursting open, display a splendid crimson or farina pulp, which contains from thirty to forty seeds, resembling raisin stones. As soon as they arrive at maturity these pods are gathered, divested of their husks, and bruised. Their pulpy substance, which seems to be the only part which constitutes the dye, is then put into a cistern, with just enough water to cover it, and in this situation it remains for seven or eight days, or until the liquor begins to ferment, which, however, may require as many weeks, according to circumstances. It is then strongly agitated with wooden paddles or beaters, to promote the separation of the pulp from the seeds. This operation is con-

tinued until these have no longer any of the coloring matter adhering to them. It is then passed through a sieve, and afterwards boiled, the coloring matter being thrown to the surface in the form of scum, or otherwise allowed to subside. In either case it is boiled in coppers till reduced to a paste, when it is made up into cakes and dried."

According to Dr. John, the following ingredients are the composition of annotto:

Coloring and resinous matters, - -	28.0
Vegetable Gluten, - - - -	26.5
Lignine, - - - - - -	20.0
Extractive coloring matter, - - -	20.0
Matter resembling gluten and extractive, -	4.0
Aromatic and acidulous matters, - -	1.5
	100.0

Muriatic acid has no action upon annotto. Nitric acid will decompose it and form several compounds. Sulphuric acid gives it a blue color, resembling indigo, but will change from blue to a dark purple. Alkalies give it a clear orange color. Chromic acid precipitates a deep orange tint.

Annotto is easily dissolved in alkalies, in which solution it is used in the dyehouse. The alkalies that are most used to dissolve annotto are potash or soda-ash, and, if light shades are wanted, some dyers use soft soap in the solution. Some keep a stock liquor on hand, but I have found it to be better if newly made. My mode of preparing annotto is this: To a barrel of water take 15 lbs. annotto, 4 lbs. carbonate of soda, 3 lbs. soft soap; boil it until the annotto is all in solution (dissolved).

The colors given by annotto are fugitive, if exposed to the light and air. Acid nor alkalies cannot completely destroy the colors dyed by it. Good annotto is of a lively red color. It is sometimes found to be adulterated with oxide of lead and ochre. These may be detected by burning it in a crucible. No sediment will be left if it is not adulterated. If there is

oxide of lead in it, by keeping the crucible at a red heat, the lead will form at the bottom; if ochre is present, there will be a red powder fall to the bottom. Annotto is crystalizable, and is then called bixine. Sulphuric acid gives bixine a yellow that does not turn red, as it does with annotto. Nitric acid gives a yellow shade; chromic acid, a deep orange tint.

Annotto was said to contain two distinct coloring principles (red and yellow), until it was shown by M. Preisser that the one was only the oxide of the other, and that they may be obtained by adding a salt of lead to a solution of annotto, which precipitates the coloring matter. This coloring matter being filtered and evaporated, will deposit itself in small crystals of a yellowish white color. These crystals will become a bright yellow by exposure to the air, but by dissolving them in water this change is prevented.

ARCHIL.

This comes to the dyer in casks containing a violet or crimson colored liquor and a large quantity of *weed*. This weed is called *Lichen Roccella*, a species of sea weed or moss, the best sort comes from the Cape De Verde Islands but it is found on the coasts of Sweden, Ireland and Wales. The coloring matters of the lichens are known in commerce as the following:

1st. As a pasty matter called archil.
2d. As a red powder called cudbear.

The mode of preparing archil is by grinding them to a pulp with water, they are then thrown into liquor containing quick lime and ammonia, after standing a few days both the plant and liquor are put into casks and it is thus received by the dyer. When it is two years old its coloring properties are fully developed, after that time it begins to deteriorate.

It gives very blooming but fugitive colors and is not much used in woolen dyeing, excepting for blooming mulberries, dahlias, &c., and for bottoming for reds, safflowers, and coch-

ineal colors, &c., it gives a depth and beautiful tint to the colors so dyed.

In order to employ it in woolen dyeing all that is required is to throw some of it into clear hot water, it does not require much boiling as the colors will work on evenly without boiling the wool or cloth. Mordants are of no use for dyeing with archil for none of the metallic or earthy salts increase its permanency. The principal consumption of it is in silk dyeing, for lavenders, lilac, and such colors as range between the pink and purple.

In 1857, Mr. Marnas of Lyons, discovered a process to make with this dyestuff a color that was beautiful and fast and called the color French Purple ; it was produced in the following manner :

" Powdered lichens are macerated with lime water, in order to render soluble the coloring matter, which combines with the lime. After filtration, muriatic acid is added, which saturates the lime, and causes the coloring substance to separate in a gelatinous state, which is washed and dissolved in hot ammonia. The solution is very slow, as it requires from twenty to twenty-five days, and a temperature of 153° Fahrenheit. The ammoniacal liquid, which has become violet, is then precipitated by chloride of calcium ; a purple lake is then produced, which is the French Purple.

Acids change the color to a -	*Bright Red.*
Alkalies " " " -	*a Blue.*
Rock Salt gives it a - -	*a Crimson Tint.*
Sal Ammoniac - - -	*a Ruby Red Tint.*
Crystals of tin - - -	*a Red Tint.*
Bi-Sulphate of Copper -	*Cherry Brown color.*

BARWOOD.

This is a hard resinous wood and is brought principally from Sierra Leone and considered in relation to dyeing, is of similar nature to camwood and sanders. M. M. Girardin and

Preisser, consider it the same as santaline or sanders; the following is the description the above chemists give of this wood.

"This wood, in the state of a coarse powder, is of a bright red color, without any taste or smell. It imparts scarcely any color to the saliva. Cold water in contact with this powder, only acquires a fawn tint after five days maceration; 100 parts of water only dissolve 2.21 of substances consisting of 0.85 coloring matter, and of 1.36 saline compounds. Boiling water becomes more strongly colored of a reddish yellow, but on cooling it deposits a part of the coloring principle in the form of a red powder. 100 parts of water at 212°, dissolve 8.86 of substances consisting of 7.24 coloring principle and 1.62 salts, especially sulphates and chlorides. On macerating the powder in strong alcohol, the liquid almost immediately acquires a very dark vinous-red color. To remove the whole of the color from 15 grains of this powder, it was necessary to treat it several times with boiling alcohol. The alcoholic liquid contained 0.23 of coloring principle and 0.004 salt; barwood contains, therefore 23 per cent. of red coloring matter, whilst sanders wood, according to Pelletier, only contains 16.75. The color that it gives is a bluer cast than either camwood or sanders and of a poorer and more feeble intensity, the molecules of its coloring matter being more widely separated from each other than they are in either camwood or sanders."

This wood gives a coloring matter that is permanent, with or without a mordant and is employed for the deep sombre colors and is not so harsh upon the wool as camwood or sanders.

It is used in the ground state the same as camwood and sanders, it being such a hard, resinous wood that the coloring principle could scarcely be extracted if it was not in a ground state. It requires a great deal of boiling to bring into solution the whole of its coloring properties.

Alcohol, alkalies, and matters containing tannin or the astringent principle, such as sumach, nut galls, etc., all aid or

facilitate the extraction of the colors of these dyewoods; but a small quantity of any metallic or other salt dissolved in the water is sufficient to prevent them from yielding up their coloring properties to water. This hint will suggest to the dyer the necessary precaution of freeing the kettle from any remains of a previous coloring before he fills it up with fresh water for another operation.

Fixed alkalies turn a solution of barwood to a dark crimson or violet; salts of tin, a blood red precipitate. Sulphuric acid darkens the color to a cochineal red; chloride of tin, brick red precipitate.

The dyer has no means of testing the value of this dyewood, owing to its insolubility in water. By turning diluted ammonia through a weighed quantity upon a filter, until all soluble matters are dissolved out, then drying the residue, the average of good barwood gives:

Wood remains, - - - -	73.4
Water, at 212°, - - - -	18.2
Coloring matter, - - - -	8.4
	100.0

MacCulloch, in his Commercial Dictionary, makes a distinction between barwood and camwood, but they are the same in chemical composition, only coming from two different places.

BRAZIL WOODS.

There are several varieties of this wood, which are distinguished from each other by the name of the place where they are obtained,—Pernambuco, Japan, Hypernic wood, Nicaragua, etc., and they all give a handsome red; and in relation to dyeing, may be considered as only different names for dyestuffs producing similar coloring effect, and only differing in some little particulars. In the dyehouse they are often all called peachwood. The wood known in commerce as Per-

nambuco is most esteemed, and has the greatest quantity of coloring matter. The kind termed Hypernic or Lima wood is the same in quality. A decoction of Lima wood presents a rich crimson color, which acids and acidulous salts will change to orange, and alkalies turn to purple. The salts of potash, soda and ammonia, change the solution into a rose color, which soon passes away by standing. Solutions of tin throw down a bright red colored lake, and alum precipitates slowly a bright and clear red.

Nicaragua or peachwood (sometimes called Santa Mathea wood) is much used in the dyehouse, and for many shades of red is preferred, although the coloring matter is not so great. It gives a bright dye. It is better adapted to coloring reds than Lima wood, and this latter is better for garnets, rubies, maroons, etc., on account of its deep crimson-colored solution. But all the colors obtained from any of these woods are of a fugitive nature, losing their brilliancy by exposure to the air. The sun has a very powerful influence upon colors dyed by these woods. By a short exposure the red color assumes a blackish tint, passes into a brown, and fades away into a light dun color.

The best preparations for reds from these woods is alum and tartar — the tartar about one-eighth the weight of alum. Some dyers use one-fourth of tartar, but that quantity is apt to give duller colors, as the super-tartrate of potash works the red of these woods on the fawn shade. For crimsons, garnets, rubies, etc., I prefer a preparation of alum and one-eighth its weight of red tartar, and one-fourth of bi-sulphate of copper. The best temperature to commence dyeing these colors is about 180 degrees, and bring up to a boil as soon as possible, and boil no longer than to get the shade required.

CAMWOOD.

This is another species of red wood, it grows in Sierra Leone, and in the countries adjacent to the Bight of Benin, and similar in its nature and chemical properties to Barwood.

It contains more coloring principle than either of the other red woods and more permanent, the colors dyed by it have a certain degree of richness not obtained with the other woods, its color is more of a decided red than barwood; with it,

Proto-sulphate of Iron	*Gives a Plum.*
Muriate of Tin - -	*Gives the solution a very bright carmine red color.*
Bi-sulphate of Copper -	*A handsome looking claret.*
Potash Sulphate of Alumina	*The solution a beautiful red color.*

Bi-sulphate of copper produces the best results upon the coloring principles of this wood and is the most proper and effectual mordant for it in most cases.

Camwood gives out its color to water with a great deal of reluctance, but astringents, alcohol, and alkalies cause it to dissolve readily in it; even one ounce of soda-ash (added gradually) for every fifteen or twenty pounds of camwood, towards the last of the boiling, and previous to entering the wool, will make a very sensible difference in the quantity of color obtained, and the wool will work more open and better than if no soda-ash had been used. The coloring matter of camwood communicates a harsh feeling to the wool or cloth, and these colors do not work quite so well, or feel so soft as when less resinous dyestuffs are used, but this objectional quality is not so great in camwood as in sanders.

COCHINEAL.

This is a small insect, called *coccus cacti.* "It is a native of those parts of South America bordering on the Gulf of Mexico, of St. Domingo, Cuba, and several other of the West India Islands, in which places it is sometimes found wild." It produces the finest known shades of crimson, red, scarlet,

etc., for woolen or silk. They feed upon the leaves of the cactus plant. The insects attach themselves to the leaves of the plant, and increase rapidly in numbers. They are a short-lived insect. The females mature in two months; the males in one month. The season of rearing and gathering lasts about seven months, in which time they are gathered three times.

After the natives have done gathering, they take some of the branches containing females and their young, and put them under shelter, and at the proper season they are distributed over the plantation. The females are put into a nest made of some downy substance, and the young quickly spread themselves on the leaves.

They are gathered by shaking them from the plants on to cotton sheets, and then put upon hot iron plates, or put into boiling water, which kills it and causes it to shrink up in the form that it comes to us, as an article of commerce. Some cultivators use steam for killing the insect, and the different appearances of the cochineal are caused by the different modes of killing the insect. The best sorts are those that appear as if dusted with white powder, and are of a slate color; but this appearance is not a sure criterion to go by, as the dealers very often dust the cochineal with powdered talc, to deceive the purchaser.

There are two kinds of cochineal, the silver and the black cochineal. The latter, as a general rule, is inferred to be the most valuable, but this is a nice distinction, and only holds good when the two kinds present the same specific resemblance; for a bold, clear silver is preferable to a black of opposite appearance.

In making choice of cochineal, you must observe that each grain exhibits a bright, free, clear, bold and large appearance; whether the whole mass be free from dust or small abraded parts of the insect, or matters foreign to its nature; and whether a quantity of it has a certain weight or specific gravity, which any person much accustomed to can distinguish with the greatest nicety.

Cochineal is the richest in coloring principle of all the known dyestuffs, having fifty per cent. of pure crystalizable coloring principle ; its clear and filtered solution, with the different mordants or mineral salts, &c., also in solution, present the following results :

Tannin does not throw down any precipitate.

Boracic acid does not change the color, but rather reddens it more.

Nitrate and nitro-muriate of per-oxide of iron, precipitates a chocolate colored lake, the nitro-muriate the brightest.

Bi-sulphate of copper, a red purple deposit, a portion of the color remains in solution.

Potash, Soda and Ammonia, change it to a crimson violet.

Protoxides of tin produce the same effect.

Per-oxide of tin changes it to a yellowish red.

Chlorine turns it yellow.

Sulphate of magnesia, no precipitate, the solution unaffected.

Lime gives scanty precipitates of a violet or deep lilac color.

Oxalic acid turns the solution orange color.

Citric acid similar effects, but of a redder hue.

Super-tartrate of potash, brightens up the solution, causing it to assume a fine scarlet color, and a slight precipitate falls of a red color.

Super-oxalate of potash produces more decided effects of the same character as the preceding.

Alum gives the liquor a fine crimson appearance and a moderate precipitate of the same color takes place, the liquor still retaining considerable coloring matter, which a solution of nitro-muriate of tin precipitates of a more decided scarlet, leaving the liquor of a pale fawn color.

I have said that the alkalies such as potash, soda and ammonia change it to a crimson or deep violet, so will the neutral alkaline salts, such as muriate of soda, &c., have similar but feebler effects.

From these experiments we can see how cochineal acts with the different mordants, and the effects of alkalies, alka-

line salts and acids, as alterants of the shade given by any particular mordant; we can gain some practical knowledge that may be beneficial to us in using this costly dyestuff, so as to produce the best effects, with the greatest economy of the article.

From these observations we find:

"1st. That Super-tartrate of potash is useful by causing cochineal to give out the coloring principle more completely to water, and that it turns its natural color more towards scarlet, and the larger the quantity of tartar, the more the scarlet assumes the aurora shade."

"2d. Therefore a given quantity of this acidulous salt is required in coloring scarlet and its shades, not only to give the peculiar tone of scarlet to the color, but also to obtain a greater quantity of it by assisting the cochineal to give out its coloring principle more abundantly than it otherwise would, but the amount of tartar must not exceed a certain proportion, because the roseate hue of the scarlet is more and more changed towards the aurora, the more excess of tartar over the just proportion."

"3d. As the scarlet color may be considered a compound of pure red or carmine and a small proportion of yellow, we could give it the yellow shade by working the cochineal towards the aurora shade, by giving an excess of super-tartrate of potash to the cochineal solution, but we lessen the cost and obtain a more desirable color, by producing the yellow part from cheaper dyestuffs, such as fustic, quercitron bark, &c."

"4th. Super-tartrate of potash is also required in coloring any shade of crimson, from a pink upwards, but in a less proportion than for the scarlet hues, because what we want of it in this case is merely to spring the cochineal, and still retain as much as we can the bright crimson tint natural to it. The proportion of super-tartrate of potash to the cochineal, in these two cases is for the scarlet 5 super-tartrate of pot-

ash to 5 cochineal; for the crimson 3 super-tartrate of potash to 5 cochineal; these proportions by weight."

"5th. That solutions of tin are the only proper mordant or base for the scarlet shades, of which solutions the nitro-muriate is the best, and that alum with an equal weight of a well saturated solution of nitro-muriate of tin, is the best for crimson shades."

"6th. That none of the other metallic salts used as mordants with cochineal, produce any better colors than can be obtained from less expensive materials; so they are of no advantage in the application of cochineal as a dye."

"7th. That all acids, and even acidulous salts, cause the colors from cochineal to pass from the crimson to the aurora or orange hue, in proportion to the quantity of real acid strength acting upon them, or in proportion to the power of the particular acid to communicate to, or abstract oxygen from the cochineal color."

"The oxalic, nitric and muriatic acids, in excess, change the color of scarlet to a deep yellow, which can never be restored to scarlet again. Notwithstanding this, the cochineal color bears a great acid power before it is much injured."

Cochineal is adulterated by taking out a part of the coloring principle, boiling in water, and then steeping it in a concentrated solution of logwood or peachwood; then drying, and covering it with ground chalk or talc. If logwood or peachwood be present, the solution remains purplish red by adding a little lime-water to the solution.

Cochineal has been the subject of several chemical investigations. The following are some of the results. The cochineal contains:

1st. Carmine or pure coloring principle.

2d. A peculiar animal matter.

3d. A fatty matter composed of stearine, bleine and volatile fatty acids.

4th. Saline matters, as phosphate of lime, carbonate of lime, chloride of potassium, phosphate of potash, combination of potash with organic acids.

Dr. John, of Berlin, gives the following as the result of his analysis:

Red coloring matter, - - -	50.0
Gelatin, - - - - -	10.5
Wax, - - - - -	10.0
Debris of skin, etc., - - -	14.0
Gummy matter, - - - -	13.0
Potash of lime, of potash and iron, and chloride of potassium, - -	2.5
	100.0

Its constituents, according to Dr. Ure's "Table of Organic Analysis," are: Carbon, 50.75; hydrogen, 5.81; oxygen, 36.53; azote, 6.91:=100.

CATECHU.

This is another substance containing a great deal of tannin or astringent principle. It is a dry extract, prepared from the wood of a sensitive plant called *Terra Japonica.* It grows in the mountainous districts of Hindostan.

"It grows to about twelve feet in height. The trunk is about one foot in diameter, and covered with a thick dark brown bark. The extract which is obtained from the tree is made from a decoction of the wood. As soon as the trees are felled, all the exterior white wood is carefully cut away. The interior or colored wood is then cut into chips; narrow-mouthed, unglazed pots are nearly filled with these, and water is added to cover them. Heat is applied, and when half the water is evaporated, the decoction, without straining, is poured into a shallow earthen vessel, and further reduced

two-thirds by boiling. It is then set in a cool place for a day, and is afterwards evaporated by the heat of the sun, care being taken to stir it occasionally during that process. When it is reduced to considerable thickness it is spread upon mats, which have been previously covered with the ashes of cow-dung; and this mass, divided by strings into quadrangular pieces, is completely dried in the sun, and is then ready for sale."

Catechu is dark brown or chocolate color, with an astringent taste, but no odor or smell. It contains about 50 per cent. of tannin principle; gum, 8; extractive matter, 35; impurities, 7:=100.

Proto-sulphate of Iron	*gives olive brown precipitates.*
Chloride of Tin	" *yellowish brown* "
Bi-sulphate of Copper	" " " "
Bichromate of Potash	*gives a deep, rich, red brown precipitate.*

There are different qualities as well as kinds of catechu in the market. I will mention but three, the Bombay, Bengal, and Malabar. The Bombay comes to us in square masses, of a reddish brown color. Its composition is: tannin, 50: extractive matter, 35; gum, 8; impurities, 7:=100.

The Bengal catechu is found in market in flattish round lumps. The outside color is a light brown; the inside, dark brown. Its composition is: tannin, 48.9; extractive matter, 37.0; gum, 7.5; impurities, 6.6:=100.

The Malabar catechu we receive in large masses. The color is of a light brown outside, but dark colored inside, and covered with leaves. Its composition is: tannin, 45.3: extractive matter, 39.5; gum, 8.5; impurities, 6.7:=100.

Catechu is adulterated with sand, clay and ochre. The adulteration can be easily detected by dissolving some of it in water, and these impurities will settle, as good catechu is all soluble in water, and gives a clear solution, of a beautiful

reddish brown color, which acids will brighten and alkalies darken, and the shade deepen by standing.

The tannin that is contained in catechu is not so easily converted by exposure into gallic acid as nutgalls are, but is subject to oxidation. When catechu is oxidized, there is a formation of an acid nearly like that of gallic acid; but this acid is only formed when a solution of catechu is treated with an alkaline matter.

Catechu is now used in almost all the compound colors on raw cotton and cotton yarns, — blacks, browns, drabs, fawns and greens; and its permanency causes it to be of such high estimation in the coloring of raw cotton at the present time.

Mr. Cooper made an analysis of a sample of catechu, giving a wider range of the matters contained in it, and which will serve to give a better idea of the various kinds or varieties of this substance; for, from the different methods of preparation, probably there are no two samples that will give the same proportions. The following is the result of his analysis:

Tannin,	62.8
Extractive or coloring matter,	8.2
Resinous matter,	2.0
Gummy matter,	8.5
Insoluble matter,	4.4
Water,	12.3
	98.2

CUDBEAR.

This coloring matter is archil in a dry and powdered state, of a lilac color; the color given by cudbear is not so blooming but is more permanent than that from archil, although it is as fugitive, still it is used more than archil for such purposes as blooming up those colors that require a purple hue to

them, it enters largely into the composition of dahlias, mulberries, peachblows, puces, logwood blues, and is used to fill up or bottom indigoes, &c.

It has all the characteristics of archil and reagents produce the same results on both. Super-tartrate of potash is the only mordant that is of any account for cudbear; it brightens up the color and helps it to resist the fulling and scouring much better than it would if not used. The sun's rays affect it easily causing it to pass from its natural shade to a dull fawn color. Colors that contain much of the archil or cudbear in their composition should be dried in the shade. (See article archil.)

FUSTIC.

The tree from which this dyestuff is prepared is known by botanists by the name of *Morus Tinctoria*, it grows spontaneously in Brazil and the West India Islands, (that from Cuba is the best.) It is uncertain when it was first introduced as a dye drug, but mention is made of it as early as 1692.

The wood is the color of sulphur, with orange colored veins; it contains two coloring principles, the one resinous and insoluble in water, the other very soluble in water, giving a deep yellow color with a light orange cast to the solution. This substance was long used for coloring yellows but is now superseded by flavine and quercitron bark. When a solution of fustic cools it becomes turbid, and a portion of the coloring principle is precipitated to the bottom of the vessel. This coloring principle has been studied by M. Chevreul who has given it the name of *morin*. A solution of fustic gives with the following reagents:

Alkalies give - -	*an orange color with a green tint.*
Muriate of Tin - -	*a rich yellow.*
Potash Sulphate Alumina	*a canary color.*

Bi-sulphate of Copper -	*a green olive.*
Proto-sulphate of Iron -	*a greenish olive tint which darkens by standing.*
Nitric Acid - - -	*a red precipitate.*

Fustic requires more boiling than logwood to extract its coloring matter, but not so much as camwood, barwood or sanders. Fustic is an indispensable article in woolen dyeing, for it is used in almost all those colors where a yellow enters into their composition and it being cheap and giving durable colors either with or without mordants, we cannot very well find a substitute for it.

F L A V I N E .

This is a coloring matter that has not been used in the dyehouse until within the last fifteen or twenty years. I do not know from what it is manufactured, therefore will not attempt to give an account of its composition, from what produced, etc. It should be mixed or dissolved in hot water before being put into the kettle or tub, and should not be allowed to stand for any length of time before using. It has superseded quercitron bark and fustic in dyeing oranges, scarlets and yellows. The quantity of coloring matter is greater than that of quercitron or fustic, one pound of flavine being equal to ten pounds of bark or thirty pounds of fustic.

The best mordant for flavine is alum, tartar, and nitro-muriate of tin. A solution of flavine will produce the following reactions with the different metallic salts:

Potash Sulphate of Alumina, -	*a very rich yellow.*
Nitro-muriate of Tin, - -	*a yellow orange.*
Muriate of Tin, - - -	*a sulphur-colored yellow.*
Proto-sulphate of Iron, - -	*a deep greenish black.*

Acids lighten the color of the solution, and alkalies deepen it, causing it to assume more of a red shade.

INDIGO.

This is a vegetable color, and belongs to a leguminous plant found in India, Africa and America, named *Indigo Fera.* There are about sixty species of this genus, and all yield indigo. The species from which it is extracted are the *I. anil*, the *I. argentea*, and the *I. tinctoria.*

"When indigo was first introduced, only a small quantity was added to the woad, by which the latter was much improved. More was afterwards gradually used, and at last the quantity became so large that the small admixture of woad served only to revive the fermentation of the indigo. Germany thus lost a production by which farmers, merchants and others acquired great riches. In consequence of the sales of woad being so much injured, a prohibition was issued against the use of indigo in Saxony in the year 1650; and in the year 1652, Duke Ernest the Pious caused a proposal to be made to the Diet by his envoy, that indigo should be entirely banished from the empire, and that an exclusive privilege should be granted to those who dyed with woad. This was followed by an imperial prohibition of indigo on the 21st of April, 1654, which was enforced with the greatest severity in his domains. The same was done in France; but in the well-known edict of 1669, in which Calbert separated the fine from the common dyers, it was stated that indigo should be used without woad; and in 1737, dyers were left at liberty to use indigo alone, or to employ a mixture of indigo and woad." —*Barlow's "Manufactures and Machinery of Great Britain."*

The indigo plant which grows in Bengal is small and straight, with thin branches which spread out in the form of a turf. The average height is about four feet. The leaves are soft, and like those of the common clover, and the blossoms are of a blue purple color, and when the plant is in full blossom it yields the greatest amount of indigo.

For the mode of extracting the indigo from the plant, see Barthollet on the "Elements of Dyeing;" Dr. Ure's "Diction-

ary of the Arts of Manufactures;" and Dr. Thomson's "Vegetable Chemistry."

The impurities in indigo are iron, clay, lime, magnesia, and silica of a substance somewhat like gluten.

Each chest you will find to contain a quantity of dust which sometimes amounts to eight or ten pounds. This dust is an adulteration composed of starch or white lead mixed with powdered indigo, and is put in the chest in order to increase its weight.

The principal varieties of indigo in commerce are the Bengal, Guatemala, Madras and the Manilla.

The varieties of the Bengal indigoes are numerous, the best varieties are:

1st. The superfine or light blue. This is in a cubical form, light and soft to the touch, of a clean fracture, and will give a beautiful copper color on being scraped with the nail.

2d. Is called superfine with a violet color by being scraped. The thirteenth variety is an ordinary and low copper-colored indigo, with a copper-colored blue or red cast, and hard to break.

The indigoes of Guatemala are of various kinds. The best are a bright blue color, and very light and fine. These indigoes are equal to the best Bengal. The inferior kinds are a violet color and as a general thing are more mixed than the Bengal kinds.

The Madras indigoes have a rough fracture. These indigoes when of the best quality, have great lightness, but are not equal to the Bengal or Guatemala. The middling kinds have a very slight copper color. The inferior kinds have a dark or muddy blue, black, or even gray, and greenish color. The Manilla indigoes are of a finer and lighter color than those of Madras, but not so fine as those of Bengal. The middling kinds are of a violet color, but are inferior to the violet of Bengal.

The tests for indigo are too numerous to insert in a book of this kind, besides being too tedious and difficult for most dyers, they not having the facilities to carry out such delicate operations as that of testing indigoes, and for more light upon this subject, dyers must consult, "Dr. Thomson's Vegetable Chemistry," and the other works mentioned in this article.

LAC DYE.

"This comes to us from the East Indies, and is the production of an insect called *coccus lacca* and *coccus ficus*: it deposits upon the branches of a tree the cellular substance called stick lac, from which the lac dye of the dyer is extracted." It is extracted by boiling the stick lac in alkaline water, which dissolves the coloring matter along with some of the resinous. To this is added some alum, which precipitates the whole as an aluminous product or cake. These cakes are then ground to a fine powder, in which condition it is received by the dyer.

"This substance came into use in England some fifty or sixty years ago, and its first introduction was in the state of lac lake, which is the coloring matter of the stick lac, but the lac lake containing a considerable quantity of resin of the stick lac, as well as other matters of an earthy or glutinous nature, it was not only very difficult to obtain a decent color from it, but the goods had a harsh, clammy, stiff, and disagreeable feeling, and dirty appearance, it being impossible to wash such sticky and insoluble matters from the cloth."

"It was quite another thing to color with lac at that time, to what it is at the present day, for dyers have been gradually improving in their methods of freeing the coloring matter from its resinous associate; until now it is rare to meet with any gummy lac, but yet we do occasionally get such an impure article in the market." "Good ground lac should be an impalpable powder, with a smooth and fine feeling like

wheat flour, having no gritty or sandy feeling, with few or no shining particles in it; neither will it have the granular appearance of gunpowder. When mixed with an equal volume of nitro-muriate of tin, it will form a bright red colored, stiff and smooth paste."

"Lac bears, and requires longer boiling than cochineal in the process of dyeing; it does not give so beautiful a color as cochineal, but it withstands the action of acid and alkaline tests better, and it retains its peculiar beauty, or resists light and the atmosphere longer than the color given by cochineal." "Lac does not contain more than one-half or two-thirds the quantity of coloring principle that cochineal does, and as the other gross quantity is matter injurious to, or of no use as a coloring substance, this will account for the difference in beauty of the two reds of lac and cochineal."

It was Dr. Bancroft who found that acids would destroy the resinous or gummy matter of lac dye, and cause the coloring principle of it to be more soluble. If you should happen to get any of the gummy lac, the best way to free it from the resin that it contains is to digest the lac in about ten times its weight of water, with about one-fourth the weight (of the lac) of oil of vitriol. (Or to be more plain, we will suppose that we are to use 16 pounds of lac; then take 160 pounds of water, with 4 pounds of sulphuric acid added to it.) After mixing it well, let it stand for two days. It is then ready for use. In dyeing, you make no account of the acid used, but put in the other materials that you would use in proportion to your lac. Some dyers take 32 parts of lac and digest it with 10 parts of muriatic acid, diluted with as much water, (10 parts) and stir it up from time to time, and set it aside for twenty-four hours.

The mordants for lac are the same as for cochineal, except the acid, which is nitro-muriate of tin, called by some lac spirits, or yellow spirits.

LOGWOOD.

The logwood tree is known to botanists by the name of *Hœmatoxylon Campeachianum.* Its bark is thin and smooth, but furnished with thorns: its leaves resemble the laurel. The wood is hard, compact, and capable of taking a fine polish. Its specific gravity is higher than water, in which it will sink.

We are not positive when it was first introduced as a coloring agent, but its nature and the art of using it as a coloring agent seems to have been but little understood in Queen Elizabeth's time. During her reign there was an act of Parliament passed entitled, "An act for the abolishing of certeine deceitful stuffe used in dyeinge of clothes:

" Whereas, there has been broughte from beyond the seas, a certeine kind of stuffe called logwood, aliase blackwood, wherewith divers dyers," etc.

"And whereas, the clothes therewith dyed are not only solde and uttered, to the greate deceyte of the Queene's loving subjects, but beyond the seas, to the greate discredite and sclaunder of the dyers of this realme."

And it further imposed a penalty (upon any dyer who should use it) of "imprisonment and the pillory."

" Upwards of a hundred years elapsed before the virtues of this wood were known and acknowledged, and at this day there is no dyewood we know of so universally used and so useful as logwood."

Like many other valuable dyestuffs, logwood was used a long time before the real nature of the coloring principle was known.

" Chevreul made a chemical examination of logwood, and found that it contained a distinct coloring substance, which he called hematine, a name which has been changed to hæmatoxyline, to avoid any confusion with a substance having a similar name, contained in blood."

Logwood contains resin and oil, sulphate of lime, and alumina, besides the coloring matter. These ingredients vary in different woods, some having more than others.

A solution of this wood is easily changed from its natural color, by alkalies to a purple, by acids to an orange. Almost all the metallic and earthy salts cause abundant precipitates or lakes, with its solutions, the colors of which vary from violet to black, and in all cases retaining a tinge of the violet hue; so that a solution of logwood always throws down a compound color, whose proportions of red and blue vary with the different metals used, and each gives deeper shades, according as it is more or less oxidized.

Tin alone, of all the metals, gives it the property of resisting acids, and by taking a proper course with a mordant of tin, you can obtain a purple as durable as indigo blue. Alum always gives violet-colored shades.

Logwood enters into all colors that have any tinge of the violet in their composition, such as drabs, leads, slates, and all the violet shades, plums, some dark browns, etc.; but its principal consumption is in logwood blues and in blacks, to which it communicates a softness and glossy lustre, unequalled by any other material.

If a well saturated decoction of logwood be evaporated, a deep plum-colored magma, of a very tough and tenacious consistency, is obtained: this is called extract of logwood, hematine, or hæmatoxyline. Chevreul's process for obtaining the extract of logwood is to digest logwood chips in water at 120° or 180° Fahrenheit, afterwards filtering the liquor and evaporating to dryness. What remains is put into alcohol for a day; this is again filtered, and the clear liquor evaporated until it becomes thick. To this is added a little water, and evaporated anew. It is then left to itself, and the coloring matter crystallizes.

The extract possesses the same properties as the decoction, and is in comparative strength to good logwood chips as 1 is to 5: that is, one pound of the extract is equal to five pounds of the chips.

Logwood grows in the West Indies and on the eastern shores of the Bay of Campeachy; that which comes from Campeachy is the best.

The action of metallic oxides upon the coloring matter of logwood is as follows:

Proto-sulphate of Iron,	*blue-black precipitates, permanent.*
Chloride of Tin,	*rich wine-color,* "
Persalts of "	*deep wine-color precipitates, which become brown.*
Acetate of Copper,	*greenish-black, passing to brown.*
Salts of Alumina,	*wine-color precipitates, permanent.*

Parks, in his "Chemical Essays," makes the following observations in regard to logwood being watered before using: "Considerable advantage is derived by woolen dyers from the use of water in the preparation of chipped logwood. As the wood is cut into chips, they sprinkle it abundantly with water, and then throw it into large heaps, and sometimes into large bins, where it is allowed to lie as long as convenient. By this treatment the chips become heated, or, in other words, they ferment, as the dyers call it, and thus undergo a very remarkable change; for after having lain a time in this state, it gives out its coloring matter more easily; and any given quantity of logwood will produce a more intense dye than could have been obtained from an equal quantity of the same logwood had it not been thus watered. It is difficult to account for this, unless we suppose that the water becomes in part decomposed, and that its oxygen, uniting with the vegetable coloring matter, renders it more intense."

Some dealers in logwood use lime with the water that they sprinkle on the wood, which increases the richness of the color, so that the poorest logwood, after being thus "doctored," looks equally as well as the best quality. Such logwood, however, never will give good shades, especially on slates and other light colors where logwood is the principal coloring matter required.

Lime may be detected in logwood by diluting a little of it in distilled water, then trying the solution with test-papers,

coloring the papers a blue violet, then passing to a brown, and finally the color decays.

I do not know of a simple and accurate method of testing logwood that could be introduced into the dyehouse, or at least none but what would take too much time and trouble for most dyers.

MADDER.

This plant or shrub, *Rubia Tinctorum*, rivals indigo as a dyedrug, both from the beauty and permanence of the colors given by it, and also from the numerous shades that can be dyed by it. Madder is raised or cultivated in France, Holland, but mostly in Holland and the Levant. The Levant or Turkish madder is the best. In France and Holland the roots are gathered every three years, in Smyrna and Cyprus they are gathered every five years. When the roots are taken from the ground they are carefully cleansed and spread on the ground to dry, it is then ground to a fine powder and put into casks, in this state it is received by the dyer. Madder should be kept in a dry place, as it easily absorbs moisture which is an injury to it; when kept dry it improves by age, its age can be ascertained by the appearance of the head of the cask, if it is two or more years old the head will be swelled out by the swelling or growing of the madder. The quality of madder is judged by the taste and smell, the good will have a heavy sweet smell, with an earthy flavor, its taste is a sweet bitter; when exposed to moisture its color will pass from the orange tint to a deep red. Madder is sometimes adulterated with brick dust, red or yellow ochres, sand, clay, sawdust from mahogany, powdered logwood, and sandal wood, &c. The mineral impurities may be detected by putting some of the madder in a glass jar and pouring boiling water upon it, the madder will float and the sand, brick dust, clay, &c., will sink to the bottom.

To detect the vegetable adulterations, Mr. Pernod, of Avignon, proposes the following tests. A sheet of white paper is immersed in a weak solution of bi-chloride of tin for a few minutes then place the paper upon glass or porcelain, and sieve the madder upon the paper; in half an hour afterwards the paper will show crimson red spots if the madder contains any of the red woods; purple spots if it contains logwood; and a yellow coloration if it contains fustic. If the madder is free from the above adulterations the paper will be colored a light yellow.

"The first investigations into the chemical properties of madder, led to the discovery of two distinct coloring matters, one, yellow which is very soluble in cold water, and named *xanthine*; the other red slightly soluble in hot water, and called *alizarine*."—See Thomson's Vegetable Chemistry.

By other investigations it is made to appear that madder has five different coloring matters, and are thus named: madder purple, madder red, madder brown, madder yellow, and madder orange.

Mr. E. Kopp found in madder the following substances:

1st. Alizarine,
2d. Purpurine,
3d. Pseudo-Purpurine,

} Which are red, or orange red, and dye red with alumina mordants.

4th. An orange substance, which dyes red with mordants of alumina.

5th. A yellow substance, (*xantho purpurine*) distinct from xanthine, and dyes yellow with mordants of alumina.

"The purpurine is equal to sixty times its own weight of powdered madder, it is soluble in ammonia, acetic acid, and water." To color wool with purpurine it is first prepared with a mordant of alum and cream of tartar, or with tartar and spirits made as follows:

3 pounds nitric acid, 1 pound water, one-half pound sal ammoniac and add one-half pound tin gradually after the liquor becomes cold; after the mixture let it be about four days

old before using it. With muriate of tin and oxalate of potash, the result will be a scarlet almost as good as a cochineal scarlet. Alum and oxalate of potash gives a crimson red. For a deep red orange, use the described spirits and tartar in the preparation, and with the purpurine use some fustic or flavine or you can use the fustic along with the spirit in the preparation, then dye with purpurine alone.

Purpurine is not affected by lime.

NICARAGUA WOOD.

See Brazil Wood.

NUT-GALLS.

Nut-galls are excrescences that grow upon a certain species of oak, (called by botanists *quercus infectoria*) which originate by punctures made by an insect (called gall wasp) for the purpose of laying their eggs. A juice comes from these holes made by the wasp, and forms into round, hard balls that will vary in size from one-fourth of an inch to three-quarters in diameter.

Nut-galls contain gallic acid as well as tannin, and they will compare one to the other as follows:

Gallic Acid.	*Tannin.*
7 Oxygen.	13 Oxygen.
3 Hydrogen.	8 Hydrogen.
5 Carbon.	17 Carbon.

I have abridged from Brande's Chemistry the following table, which will give an idea of the action of some of the metallic salts upon a solution of nut-galls:

Name of salts used.	Color of the precipitates.
Copperas - - -	*gives black precipitates.*
Nitro-muriate of Tin -	" *fawn-color precipitates.*
Muriate of Tin - -	" *straw-color* "
Blue Vitriol - -	" *yellow-brown* "
Proto-nitrate of Mercury	" *yellow* "
Nitrate of Copper -	" *grass-green* "

I find that the composition of galls, by analysis, is as follows in 100 parts: tannin, 33.5; gallic acid, 5; woody fibre, 10; water, 12; gum, 4.5; insoluble parts, 35.

The analysis of galls by M. Guibourt is as follows in 100 parts: woody fibre, 10.5; water, 11.5: tannin, 65; gallic acid, 4; extractive matter, 2.5; starch, 2; sugar, 2; gum, 2.5.

Other chemists give in 100 parts: tannin, 26; gallic acid, 6.20; gum, 4.80; and the insoluble parts, 63:=100.

There are several kinds of nut-galls, those from the East Indies, Smyrna and Aleppo; and they differ according to the ripeness of the nuts. Some will be black, some green, and others white galls; some are mixed, and are called natural galls. The blue Aleppo galls are considered the best, the Smyrna next.

Nut-galls come to the dyer in a ground state, so he does not have the chance to judge of purity or goodness.

"The combining proportions of nut-galls and sulphate of iron are as 4 is to 1:" that is, one pound of sulphate of iron will precipitate four pounds of nut-galls.

PEACHWOOD.

See Brazil Wood.

QUERCITRON BARK.

This drug is the inside bark of the black oak (named by botanists *quercus nigra*) ground or bruised. It was formerly used for dyeing yellows, oranges, and other colors wherein the yellow is predominant, but is now superseded by flavine. It is very rich in coloring principle, and water just below the boiling point will extract the color from it more abundantly than if it is boiled hard, as by boiling we extract a large quantity of tannin or astringency which is detrimental to the color, if we wish to have a clear and brilliant shade. A strong solution of this bark when evaporated will leave a resinous substance of a cinnamon color, which is called extract of quercitrine. One pound of this bark is equal to three pounds of fustic in coloring principle. Its coloring properties were discovered and made known to the public in 1783 or 1784, by Dr. Bancroft; some three years afterwards there was an act passed by Parliament, giving him the exclusive use and application of it for a term of years.

A solution of this bark will give the following results with reagents:

Alkalies, - - - -	*a deep orange color.*
Alum - - - -	*a canary yellow.*
Muriate of Tin - - -	*a reddish yellow.*
Nitro-muriate of Tin - -	*a rich yellow.*
Copperas - - - -	*a greenish olive tint.*
Nitric Acid - - -	*a red precipitate.*
Sulphuric Acid - - -	*a red precipitate, after standing awhile.*

Chevreul extracted the coloring principle from quercitron bark and obtained a crystaline substance of a sulphur yellow color, which he called *quercitrine* and like all other extractive coloring matters must be considered the oxide of a colorless base. The composition of quercitrine is: water, 1; hydrogen, 8; oxygen, 9; carbon, 16.

The proper mordant is alum, super-tartrate of potash and murio-sulphate of tin, the whole mordant combined about

one-half the weight of bark employed, and the bark to be 2 pounds for every ten pounds of wool for the fullest yellow. The proportions of the two acids that compose the solution of tin, must be made to vary, as we wish to get yellows of a lemon shade, or yellows of an orange shade ; for the orange hue, we must have the greatest proportion of muriatic acid, and for the lemon hue we must have an equal quantity, or more, of sulphuric acid, or a sulpho-muriate of tin. As a general rule for determining the inclination of this coloring matter, either to the lemon or orange cast of shade, will be (supposing we are using the murio-sulphate of tin, and we want to vary from a common yellow,) to decrease the amount of alum and tartar, (more particularly the tartar,) and make up the deficiency with muriate of tin, and boil well for the orange cast, and for the lemon cast it will be, to increase the amount of alum and tartar, especially the tartar, and diminish the amount of tin solution, and making up the deficiency, when a decided lemon shade is wanted, by the addition of sulphuric acid equal in volume to half the solution of tin left out, that is supposing you are leaving out 2 pounds of the tin solution, you must add 1 pound of sulphuric acid to the remaining tin solution. We can give the lemon shade without so much trouble, by just tinging the dyeing bath with the least imaginable amount of sulphate of indigo ; and the orange cast by cochineal, or a little carbonate of soda; but it will be best to give the particular hues, by a variation in the mordant.

SANDERS OR SAUNDERS WOOD.

This is the wood of a tree that grows in the East Indies and on the coast of Coromandel. It is harder and more resinous than barwood or camwood ; but, according to some chemists, it is a variety of barwood ; at least they say the

coloring principle is of the same composition, and term it *santaline.*

Astringents, such as sumach, galls, etc., aid the water in extracting the coloring matter from this wood. Alcohol only can extract the whole of its coloring matter. It requires more boiling than any other dyewood to extract its color.

Without mordants it gives a rather dull orange-red color, which is very durable on woolen goods. Sanders containing more tannin than barwood or camwood gives a harsher feeling to the wool dyed with it, but for some particular colors and purposes it is preferable to them. Its composition is: oxygen, 32; hydrogen, 8; carbon, 16.

SUMACH.

Sumach is a native of Syria, and is cultivated in Spain, Italy, Portugal and Sicily. Its botanical name is *Rhus Coriaria*. The shoots are cut down every year, dried, then ground to a fine powder; in this manner it is received in market.

A boiling decoction of this powder has a fragrant and agreeable odor, not unlike good tea. The color is a fawn drab, which the acids change more to a yellow, and the alkalies to a browner orange hue. Alum and the solutions of tin yield fawn-colored or brownish yellow precipitates. Bi-sulphate of copper throws down drab precipitates. Proto-sulphate of iron gives lead-colored precipitates, verging on black.

"A strong solution of sumach gives very near the same results as a weak solution of nut-galls, the greatest difference between the two being in the quantity of tannin and gallic acid which they contain. The difference in the two vary the effects, so that we may, in most cases, substitute a certain quantity of sumach for a part of the nut-galls: yet, in no case, can it be supposed that sumach, in any quantity, produces the same results as nut-galls. Ground sumach contains

one-sixth its weight of tannin, and a small amount of gallic acid, and considerable of a yellow coloring principle; and the combining proportions between it and sulphate of iron are about six pounds of sumach to one pound of the sulphate of iron."

WOAD.

"As this material is of so much consequence in the important business of blue-dyeing, and forms the basis of the composition of the woad-vat, and as the regulation of its fermentation constitutes the knowledge of the woad man — and the lack of which is the cause of those difficulties and disasters that sometimes occur in conducting this most delicate and inexplicable process of dyeing — it will be necessary that we should be very particular and correct in our description of the manufacture, qualities, and mode of operation of a substance on which so much depends.

"The expensive materials and complicated nature of the woad-vat: the little we know of this species of fermentation; the practical experience and the great skill required in the dyer, successfully to conduct them, all demand that whatever ideas he may imbibe relating thereto ought to be true ones, and founded upon a knowledge of those chemical changes incident to them, which take place only in virtue of the power of certain laws that govern the action of one species of matter upon another species, apportions their combining quantities, and stamps a character upon the product. A knowledge of these laws or attractions will convince him that the aspects presented by the woad-vat are not the productions of mere chance, but the effects of determinate and well-regulated action; and it only requires to understand the affinities that cause, to comprehend the change that will result from their operations; and these being once known, will dispel all the uncertainty, and reveal all the mysteries connected with the management of this invaluable branch of the art of dyeing.

"Knowing then, the need and the importance of diffusing no other than correct information relative to so important an article as woad, we shall be careful in what we say about this comparatively unknown subject, to base our observations on the facts revealed by experience, and in accordance with the principles that regulate the operations of the woad-vat, leaving the full development of its nature and effects to future investigations, either by ourselves, or others who may have greater facilities and qualifications for such an undertaking.

"The plant, (*Isatis Glastum* or *Isatis Tinctoria*) when made into a fermented paste or balls are in this state called woad, is a native plant of England, and has been used as a coloring material (either to stain the bodies of the savage Britons or to dye the garments of their more civilized descendants) for two thousand years; and the accumulated experience of ages, transmitted from father to son, hath given to the artizans of that country a mass of practical information regarding its manufacture and mode of operation, such as those of no other nation possess.

"The woad plant is cultivated in Great Britain, France and Germany, and when the cultivator judges it to be sufficiently matured, it is cut, and then ground into a sort of pasty mass, which is piled in a heap; when, after a time, heat is generated, and fermentation commences with the disengagement of ammoniacal gas. During the progress of this process the heap is turned or worked over, sprinkled with water or lime, as the cultivator thinks best, in order to regulate temperature and accelerate the fermentation, or retard its too rapid operation. This treatment is continued for two or three weeks, according to the state of the weather, or other circumstances, and the process is called couching. When the process of couching has commenced, the operation that is going on is precisely the same as that which takes place in a manure heap when that is suffered to ferment.

"The couched or cask woad differs from the balled woad, inasmuch as the latter is merely the ground plant made up into balls and dried under an open shed, without having un-

dergone the process of couching, as described in the manufacture of the cask or paste woad.

"We will now describe the marketable qualities of woad, to enable the dyer to make a judicious choice of such kinds as are good, and safe to work. There are three general appearances of cask woad only that we will notice — the brown or foxy; the dark-colored and muddy woad; and the fine olive-green colored and fragrant-smelling woad. The best is of a green-olive color, interspersed with parts of a browner appearance. It is rather tough and adherent than otherwise. When a piece of it is gently broken open, it strings out into fine, silky fibres, which have considerable tenacity. It has an agreeable and sweetish ammoniacal smell. When mixed with water it does not dissolve very readily or fall apart, but has a doughy toughness, and requires considerable working to convert it into a light, pulpy substance. When so dissolved, its soluble portion gives to water a deep brown color, inclining to olive, and the liquor has considerable body to it. These are the distinguishing characteristics of a good woad, and shows that the couching or preparation of the woad plant was properly conducted.

"The brown or foxy woad differs in appearance from the preceding description, chiefly in color, which is redder or more decidedly brown; also, it has a stronger and less agreeable odor. In other respects it answers the description of the greener or more olive kind, if the article be good. A first-rate foxy or brown woad is much stronger than the one we have described as the best; but it is a very dangerous article to work, for it works in such a rapid manner, that a great deal more watchfulness and skill are required in bringing it to work properly than any other kind. It requires a great deal more ware, and, as its fermenting powers are so strong, it frequently takes plunges of violent fermentation that require considerable skill to manage; therefore, this kind is very unsafe in the hands of an inexperienced blue

dyer. The cause of this woad working so rapid and fitful is on account of its not being sufficiently fermented in the process of couching; and its red color might be caused by the plant having been too much matured before it was gathered; or possibly from other circumstances and causes that we are not acquainted with.

"We have now to caution you against the worst of all kinds of woad, which we too often find in the market. I mean that heavy, lifeless, dark, muddy article, whose circulation among the dyehouses is known, by us hearing of difficulties experienced in working the woad-vats all through the country; or at least, at those places where this spurious article has found its way. This substance (for I cannot call it woad) is very mobile, having little or no adherence in its parts, nor possessing any tenacity; it will not hold together in the least, but breaks off without any filamentary or fibrous appearance. It is short and earthy, and its odor is similar to that of dock mud, from which it can be scarcely distinguished by a superficial observation. On being thrown into the hot water of the vat, it readily falls to pieces, and needs little or no raking up. The appearance of the liquor formed by it is gray-colored, wavy, and glistens as though it was greasy; it looks like strong, dirty soap-water that colored clothes have been washed in. The smell of this liquor is vapid, and not like the exhilarating odor of a new-set vat. I will not enter into a detailed account of its different modes of operation in the vat, or give an opinion of the causes, but will caution the dyer not to purchase, and more particularly, not to use such an article.

"The constituents of woad are: 4 hydrogen; 3 azote; 2 carbon; 1 oxygen: all in an uncombined state."—*From Gibson's "System and Science of Color."*

YOUNG FUSTIC.

Young fustic, venus sumach or fustet. Young fustic is a shrub (*Rhus Cotinus*,) and is used to give the yellow tinge peculiar to the European scarlets, it is also used for buffs, canes, melon and nasturtion colors; it is better for giving the yellow part to these colors than any other yellow dyestuff especially where cochineal is used to give the red part.

There is little of this dyestuff imported to this country. When it is first cut down it is striped of its bark and cut into small pieces; it contains a great amount of yellow coloring matter called fusteric. A solution of young fustic gives with other substances the following precipitates:

The different salts of Tin,	*Gives*	*an orange yellow precipitate.*
Proto-sulphate of Iron	"	*olive-green color.*
Acetate of Lead -	"	*a yellowish white.*
Alkalies - - - -		*change the colors to red.*

The coloring matter of this wood has a great attraction for oxygen, a principle which effects its use as a dye, causing the colors made from it to be fugitive, but it is durable enough to be employed for the above named colors, but it is not adapted for making full yellows, oranges, or colors that are very deep and in those colors where the yellow predominates over the red. It is used mostly on silks for some particular shades when yellow dyestuffs are used.

MORDANTS OR CHEMICAL SALTS.

The Alkalies.—Ammonia, Soda Ash, Sal Ammoniac, Pot and Pearlash, Lime.

The Salts.—Alum, Cream of Tartar, Muriate of Tin, Murio-sulphate of Tin, Nitro-muriate of Tin, Bi-sulphate of Copper, Argals, Prussiate of Potash, Bi-chromate of Potash, Proto-sulphate of Iron, Oxalic Acid.

The Acids.—Sulphuric, Nitric, Muriatic.

THE ALKALIES.

AMMONIA.

Ammonia is an alkaline compound composed of one part nitrogen, and three parts hydrogen, it is an elastic and invisible gas, in this state it is sometimes called the volatile alkali. "It is obtained pure by mixing equal weights of lime and muriate of ammonia (sal ammoniac) well powdered, and exposing them to a gentle heat in a retort; when the lime combines with the muriatic acid contained in the muriate of ammonia and liberates the ammoniacal gas, which is received into a jar over mercury for experiments, but is conveyed by a tube into water for the use of manufactories. In this state it is known as aqueous ammonia, water of ammonia, or spirits of hartshorn." Ammonia is also obtained from the destructive distillation of organic matters containing nitrogen such as bones, skins, blood, and other animal matters. It is also obtained as a product of the gas works. When animal matters are decomposed by burning or petrification, ammonia is formed, and produces the disagreeable smell which these operations generally give.

The ammoniacal liquors obtained from gas-works, or by distilling animal matters, are saturated with muriatic acid, which converts the ammonia into muriate of ammonia, (sal-ammoniac) which crystallizes in a very impure state. These crystals are placed in iron pots lined with fire-brick, having a cover of lead fitted to the pots. Fire is then built under the pots; the muriate of ammonia sublimes and forms a crust upon the leaden cover, from which it is taken off at intervals.

"Water will absorb ammonia (ammoniacal gas) with great rapidity, taking up about one-third of its weight, or 460 times its bulk of the gas, which will increase the volume of

the water one-half, and lower its specific gravity from 1000 to 0.875, and it then holds in solution 32½ per cent. of pure ammonia. The specific gravity of aqua ammonia ranges from 0.875 to 0.995; at 0.875 it contains 32½ per cent. of ammonia, and at 0.995 only 1⅓ per cent."

It is employed for the manufacture of archil and cudbear, for bringing out the color, and for raising the color of a decoction of logwood, etc. It is generated during the fermentation of the woad-vat, and is the alkali that holds the indigo in solution in the vat, and it has the peculiar odor exhaled from woad. Its aqueous combination dissolves the oxides of zinc, iron, copper and tin, and even zinc when in the metallic state. It possesses more alkaline strength than either soda, potash, lime, or potash soap; yet it does not act with such destructive energy upon wool or woolen fabrics as any of these do.

"It is, therefore, the safest and best alkali to use for woolen fabrics in those processes that require the intervention of an alkali. Its various combinations, as urine, etc., carry with them into the processes of dyeing all the mild qualities which render ammonia itself so effective and safe; hence arise the superior strength and softness of such wool as has been scoured with urine, or dyed in the woad-vat, over such as has been scoured or dyed by the employment of any of the other alkaline articles."

"Ammonia should be employed for all such purposes in dyeing as require the presence of an alkaline principle, and is always the best, because the attenuation of its substance being the greatest, it will consequently produce the finest effects."

SODA-ASH.

Soda was not distinguished from potash until near the middle of the eighteenth century, when their different characters were recognized. The potash was called the vegetable, and

the soda the mineral, alkali. Soda is an element that is abundant in nature; it is found in combination: that is, as nitrate of soda and muriate of sodium.

The muriate of sodium is the source from which soda-ash is produced, and since the process of making it from this alkali (sodium) was discovered, it has been used instead of potash more or less in all the arts. It is manufactured in Spain and Great Britain by placing a large quantity of common salt upon the bottom of a heated furnace; then sulphuric acid is let into it from an apparatus on the top of the furnace, and then the salt is decomposed. The muriatic acid passes off with the steam. During this operation the salt has to be stirred at intervals, and in four or five hours it is withdrawn from the furnace. It is then reduced to a powder, and ground chalk, equal in weight to the powder, and half as much well ground and sifted coal, is mixed with it. This mixture is then put again into a hot furnace and frequently stirred, until it is uniformly heated. In an hour it will fuse. It is then well stirred for a few minutes and drawn out into a cast-iron trough, where it cools and solidifies. This is called British barrilla, and is of great alkaline strength, containing about 30 per cent. of alkali.

When the cake of soda has become cold, it is broken up (in order to separate it from the insoluble matters) and put into vats and covered with tepid water. In about four hours the liquor is drawn off from the bottom, and then washed six or eight times more, which extracts all the soluble matters from it. These liquors are all put together and then boiled down to dryness, that forms a salt of carbonate of soda, which contains a little caustic soda and sulphuret of sodium. To get rid of the sulphuret, they mix the salt with about one-third of its bulk of sawdust, then expose it to a low heat in another furnace for a few hours, which converts the caustic soda into a carbonate that carries off the sulphur. The product of this contains nearly 50 per cent. of alkali, and makes the best quality of soda-ash.

The per centage of alkali contained in soda-ash is very uncertain: it varies from 40 to 50 per cent., and it is generally priced according to its per centage. I might give a rule or method for ascertaining the per centage, but it requires a great deal of trouble and time, and it would not be of any service to dyers, as the purposes for which they use it is of no consequence what per centage of alkali it contains. It might benefit dealers in soda-ash to give a method for finding the per cent. of alkali in it: but I doubt if they would take the trouble to perform the operation.

There is an impure soda-ash made from sea-weed (sal sola soda). This article does not contain over six or eight per cent. of real soda. An impure soda exists naturally near the lakes in different parts of Africa.

"Soda-ash is soluble in twice its weight of cold water, and in an equal weight of boiling water. It is composed of 15.3 carbonic acid: 22 of soda: 62.7 water of crystallization, in 100. In a dry atmosphere its water of crystallization evaporates, and the salt falls into a powder: one pound of the powder is as strong as two of the crystals. The prime equivalent of the dry powder is 6.75: when in crystals it is 18. Boiled with quick lime deprives it of its carbonic acid, and when evaporated to dryness, is then a pure soda. Its combining proportion with acid is 4."

Soda-ash does not act in so caustic a manner upon wool or woolen fabrics as potash or lime, and should be used instead of the two latter articles whenever necessity compels us to use a fixed alkali in our operations on wool, for scouring or any other purpose. A solution of soda-ash brought to a boil will attain 266 degrees Fahrenheit. 100 parts of water will dissolve 40 parts of caustic soda. The same amount of water at 175 degrees of heat dissolves 75 parts of soda.

POTASH AND PEARLASH.

These articles are sometimes called the vegetable alkalies. When wood or other vegetable substances are slowly burned until all the inflammable matters are condensed, there will remain a substance called ash. The ash consists of the mineral ingredients of the vegetables with potash, lime and other earthy matters. The soluble matters along with the potash are extracted from the ash with water.

The amount of ash obtained from wood is about 1 per cent. In the United States and Canada the wood is cut down in the forests and heaped into piles and burned for the purpose of making the potash.

The ashes made from the burnt wood are put into cisterns with false bottoms, and plugs under this false bottom to draw off the liquor, water is poured into these cisterns among the ashes, it is then stirred and allowed to settle for a few hours, all the soluble matters are dissolved and the liquor is drawn off, evaporated to dryness and then fused at a red heat into a compact mass and is then called potash. The pearlash is made from potash by putting the potash in a furnace and heating it until all the carbonaceous matters and the sulphur contained in the potash are driven off; what remains is then dissolved in water and the solution is evaporated in iron pots to dryness. The pearlash does not contain so much alkali as potash. Dr. Ure states (*Dictionary of Arts*, *&c.*,) that he found in the best pink colored Canadian potash 60 per cent. of real potash, while the best pearlash did not contain but 50 per cent. These are the two states in which they are introduced in the dyehouse and then only in cotton dyehouses. They were formerly employed in woolen dyehouses for scouring wool and composed a part of the soap made for fulling and scouring of woolen cloths, through a mistaken idea of economy, but when the manufacturers used these articles their cloth was most noted for being rotten and having poor colors. Every one knows that potash is a very caustic substance and acts upon woolen goods and wool in a corrosive

manner, leaving it harsh and coarse in the feeling of the goods. "There is no operation in the manufacturing of woolen goods that requires the use of potash, except in dyeing blue in the ash-vat; and when used in the ash-vat the carbonic acid that is generated by the fermentation of the madder and bran will saturate this alkali and modify its effects, but for all that it will leave the wool or cloth harsher than if colored in a woad-vat and for which reason an ash vat should never be used for coloring wool, except in extreme cases of necessity, and then only for the coarsest grades of wool or cloth."

LIME.

Lime is known by the name of *Calcicum* in chemistry. Caustic lime is obtained by burning the lime stone in a kiln, driving off the carbonic acid and the caustic or burnt lime remains. The caustic lime will combine rapidly with one equivalent of water when a hydrate of lime is formed, called by dyers, ware, (but commonly termed *slacked lime*) in which condition it is used in the woad-vat to neutralize the excess of carbonic acid. During the slacking of lime for the blue vat, heat is evolved from the water and it passes from the fluid to a solid state by combining with the lime. Lime for the woad or blue vat must be the purest and best kind, (it must not be air slacked as it will not do for the vat then,) brown or magnesia lime will not do for this purpose. Lime is not employed in woolen dyeing except for the blue vat. It is soluble in water, it takes 85 gallons of water at 70 degrees to dissolve one pound of lime, and 135 gallons at 212 degrees (or boiling water); sugar will increase its solubility as one pound of sugar takes up one pound of lime. "The specific gravity of lime is 2.3, and its prime equivalent 3.5." For the blue vat it should be fresh slacked, for if it has been long slacked it absorbs carbonic acid and becomes converted into chalk.

CHEMICAL SALTS OR MORDANTS.

"Their variety is almost indefinite, being as numerous as it is possible for all the acids to form different combinations, in variable proportions, with all the alkalies, earths and metals."

"They are either neutral, sub or super salts, that is the acid and the base or radical, are either in the proportions to mutually saturate each other, and form a neutral compound, or the base is not fully saturated with the acid, in which case it is a sub-salt; or the acid prevails over the base, when it is said to be super-saturated with it, it is then a super-salt. They are distinguished as the alkaline, earthy or metallic salts, according as these respective substances form the base or radical of the salt."

"Two or more of them are capable of uniting together, and also two bases can unite to one acid, or two acids to one base, forming compound, triple, &c., salts."

If the numerous coloring substances that we use in dyeing had an affinity for the wool or cotton in its natural state dyeing would be a very simple process, and every one could be a dyer, for all that would be required would be to make a solution of the dyestuff and dip the wool or cloth in it and it is colored. But this we find is not the case, with the exception of indigo there is scarcely a dyestuff that will impart its own color to goods, that deserves the name of color.

This want of affinity is what makes dyeing so intricate and makes it more dependent upon chemistry; it is only by the nicest arrangement of chemical laws, that enables the dyer to turn to his advantage the different coloring matters he may be in possession of. The close alliance of the art of dyeing to the science of chemistry is evident, for dyeing we may say depends wholly upon chemistry for its full development and successful practice. But a dyer may know from experience the chemical actions of the mordants upon the coloring matters; knowledge however, procured only by routine practice is purchased at a great cost (to some one,) and is attended with a great many very unpleasant circumstances, and the student of the art of dyeing should understand chemistry, at

least so far as it is applied to dyeing, before he attempts the practice of it with the hope of successful results to himself and employer. All of the mordants are found among the metalic oxides, with but one or two exceptions. In order for the substance to act as a mordant, it has to possess certain properties to have an attraction for coloring matters, so as to form with it an insoluble colored compound, that will be easily held in solution. It also may have an affinity or tendency to unite with the fibre, but this property is not always necessary; the first two properties are only so, and they limit the mordants wholly to those bases that are termed insoluble, that is, those substances which are not by themselves soluble in water.

The principal and most essential part of all coloring operations is a right choice and proper application of the mordants. There being a chemical union between the mordant and the coloring matter, a new substance is formed, differing not only in properties but in color from any of the originals, therefore, a very little alteration in the quality or the strength of the mordant gives an alteration in the shade of the color. Thus, by carefully studying the conditions of the mordants, and the relation they have to the coloring matter, the reactions which will take place under the varied circumstances of their application, and what kind of reaction will be required to obtain the results we want, the dyer will then find his trade not only easy but pleasant and most interesting. He will find that if the mind guides the hand, labor will not be felt either as a curse or a degradation.

It is very necessary that the mordants should have a prime equivalent to the coloring matter, and if the doctrine of prime equivalents was brought into practical operation in dyeing, for as the dyestuffs and mordants do naturally combine in determinate and definite quantities only, we should in forming colors, take merely that just proportion or prime equivalent of each of the constituents necessary to form that definite combination, as any excess of either of them is a loss in the materials or an injury to the fabric or both.

What these combining proportions are, we have yet to learn by a series of well conducted experiments, which will necessarily take up too much time, and require greater facilities than a hired dyer can possibly afford or command.

A table or tables of the above character would be of the greatest importance to the economy of dyeing and it is only by an attentive and systematic study of the specific properties of the mordants and coloring matter in their relations to each other that we can hope to direct the future progress of the art of dyeing to its ultimate perfection.

We shall only notice such of those materials that form mordants or sadden to colors in woolen dyeing, or are mentioned in connection with coloring in our present work.

POTASH, SULPHATE OF ALUMINA, OR ALUM.

"This is an earthy salt, and is extensively used in dyeing as a base or mordant for almost all the different shades and colors, and super-tartrate of potash is, as a general thing, used along with it for woolen dyeing.

"In the process of combining alum with wool it has been shown by MM. Berthollet, Thenard and Roard, that alum unites entirely with wool, without any decomposition of the salt, but that the tartar is deprived of its excess of acid, which unites with the alum and wool, leaving the neutral tartrate of potash in solution in the preparation liquor; so that a preparation of alum or tartar impregnates the wool with a salt composed of sulphuric and tartaric acids, potash and alumina."

But, independent of the above effect, which might be produced by any other acid, tartar appears to be capable of effecting a further object, by inducing a double decomposition, which transforms the alum into a tartrate of alumina.

All the above results are brought about only at the boiling point, for if we should dip wool into a cold solution of alum

and tartar, then dip it into boiling water, it would part with all the alum which it received in the cold bath; but when the wool is boiled in the alum solution, it yields to this liquor a portion of its organic matter, which becomes dissolved; but, at the same time, it will absorb an equal amount of the alum. The presence of alum upon the wool when we take it out of the preparation liquor is quite evident, but the presence of sulphuric and tartaric acids and potash is only presumable.

Alum is manufactured both in England and America. The alum of this country is made from an *alum shale*, a kind of clay slate. The ore is piled up in large heaps, with alternate layers of wood or coal; then these heaps are set on fire, and are kept burning for some weeks. After the fire is put out, the material of the heaps is put into large tanks and water is let into these tanks, which dissolves out the sulphates formed by the burning; the solution is then run into other tanks and evaporated. When the solution is in this way sufficiently concentrated, the sulphate of iron contained in the solution crystallizes, and is then removed. The sulphate of alumina, being very hard to crystallize, will remain in solution. The sulphate of alumina in solution is placed in other vessels; there is then added to it sulphate of potash, or other salts of potash. Then there is formed the double salt of potash and alumina, which is alum, and after standing a few days, crystallizes, and is then packed for market. Sulphate of ammonia can be and is used instead of potash, giving an ammonia alum. Most of the alum we get now is ammonia alum, with but one exception, and that is an alum called the "Natrona porous alum," manufactured at Natrona, Penn., (Clifford Pemberton, Esq., agent, Pittsburg, Penn.)

In an analysis made of this alum I could find only a trace of potash and no ammonia. It is perfectly free from sulphuret of iron, which cannot be said of other alums; and it does not contain an excess of acid. It contains more alumina than either the Roman or English alum, and for that it is so well adapted for a mordant on prints or plain colored cotton fabrics.

Alum has a very feeble attraction for cotton, on account of the iron in combination with the acid and alumina, for which reason it is a feeble mordant for cotton (that is, the English or common alum, so called); but the Natrona alum, being free from iron and ammonia, makes it a powerful mordant in comparison to other alums. The Natrona contains in 100 parts, 17.10 of alumina, the English but 10.86, and the Roman 11.09. The specific gravity of a concentrated solution of Natrona alum is 1.530, of the alum itself, 1.760; that of the English is 1.485, of the alum itself, 1.695: showing quite a difference in favor of the Natrona porous alum.

In coloring yellows, oranges, crimsons or reds, on wool, the above alum gives a brighter and more intense hue than any other alum in the market, besides the advantage of not having to use so much of it. All dyers know that an excess of alum will make the wool more harsh, and the more alum is used, the stronger the soap will have to be for scouring and fulling the cloth in the process of finishing, which is an injury to all colors; and after any dyer has once tried the Natrona alum, I have not the least hesitation in asserting that he will use no other, if it is possible for him to obtain the Natrona porous alum.

In using the Natrona alum, most of the dyers will take as much of it as they would of the lump alum, as they think that just such a quantity of alum must be used, no matter whether one kind contains ten parts and another kind contains seventeen parts of alumina, in a given amount of the alum. This is not only a waste of alum, but an injury to the wool and color.

In all the recipes in this book where alum is used, if you are employing the Natrona porous, use one-third less than the amount given in the recipes, except in those for greens which were colored with the Natrona alum. (See recipes for greens, and remarks, at the close.)

Iron can be detected in alum by dissolving some of it in distilled water, then add to it a few drops of dissolved red prussiate of potash, or else boil some alum with a few drops

of nitric-acid, then add yellow prussiate of potash, in both cases if there is iron in the alum the solution will turn to a blue color, or if you add a few drops of gallic acid to a solution of alum, it will give a black color if there is iron contained in the alum, or you can make a solution of a small piece of alum, then add caustic potash to it until the solution is very alkaline, then boil this solution and if iron is present in the alum it will form at the bottom in a brownish glutinous mass. When you have found that the alum contains iron you had better reject it entirely, especially if you require it for any bright light shades; you will experience a great deal of difficulty from alum containing any of the oxides of iron when trying to color to a particular shade, and more especially on light fawns or drabs. Pur~~pl~~e alum is all soluble in water; 1 gallon of boiling water will dissolve 30 pounds of alum, and it will take 40 gallons of cold water to dissolve the same quantity.

SUPER-TARTRATE OF POTASH OR CREAM OF TARTAR.

This salt is of general application in woolen dyeing as an auxilliary to the mordants, but is more especially used along with alum; tartar is a very feeble mordant alone, but when used with alum or a solution of tin it is then a strong mordant: owing to decomposition the sulphuric acid of the alum, and the chlorine with the tin, takes from the tartar the potash that it contains, and the alumina or tin, are converted into a tartrate, in that state the tartar will combine with the wool more readily and will not be so destructive to the wool, as the wool dissolves and an equivalent of the mordant takes its place, as spoken of in regard to alum.

Cream of tartar, the acidulous tartrate of potash or supertartrate of potash, (and by some chemists called bi-tartrate of potash,) is obtained by treating argol or the crude super-

tartrate of potash with charcoal and clay, and repeated crystallizations. "Cream of tartar is of but slight solubility in water, as it takes sixty times its weight of cold water to dissolve it, and fifteen times its weight of boiling water to do it; but one fifth of its weight of borate of soda makes it very soluble." "The specific gravity of this salt according to Berzelius, is, tartaric acid, 70.45; potash, 24.8; water, 4.75 in 100 parts. Its prime equivalent is 23.825."

SOLUTIONS OF TIN.

OBSERVATIONS ON MAKING TIN SOLUTIONS.

In making these solutions you must have the tin well granulated, and of the best kind (see article Tin); add the tin at intervals, and a small quantity at a time, so that it may be dissolved with as little disengagement of the acid gas as possible; and keep the solution at as low a temperature as is compatible with the combination of the acids and tin. These observations apply with the greatest force in making nitro-muriate of tin.

In dissolving tin in muriatic acid, you will sometimes notice that when the tin is in solution, some parts of the tin are dissolved, while some of it seems to be covered with some sort of a crystalline substance which you have a great deal of difficulty to dissolve, and it occasions both loss and annoyance. This you can guard against by stirring the solution at intervals. This coating of the tin is caused by one part of the solution becoming denser than some other portions, an action of a galvanic nature being induced between those parts of the tin in the stronger portion and the parts in the weaker portion of the solution, causing a deposit of oxide of tin upon the metal in the weaker part of the solution.

The preparation of tin solutions is a matter of much pride among dyers, and every dyer will have some little peculiarity in making them that he keeps to himself (*as a great secret*), and on the strength of which he thinks his success depends. These little *peculiarities* are nothing more than the proportioning of the acid and the tin and the way of mixing them.

The first process of preparing the solutions of tin is to *feather* the tin, which is done by melting the bar in an iron ladle, or some other convenient vessel. After it is melted pour it into a vessel filled with cold water, holding the melted tin as high as possible, so that it may pour in drops into the water. The tin, after it is poured into the water, is beautiful beyond description. In this state a very extended surface of the metal is exposed to the action of the acid.

There are various solutions of tin, but I shall give a description of, and the manner of making, only such as are used in woolen dyeing. In giving the tin I do not go entirely by weight, but give enough to saturate all the acid; or, in other words, have the tin in excess. But be sure and not give the tin too rapidly, and let your solutions be a few days old before using them.

The introduction of tin as a mordant may be considered as forming an era in the art of dyeing, and was discovered accidentally, and is spoken of by Berthollet in his "Elements of Dyeing" as follows:

"A short time after cochineal became known in England, the scarlet process by means of tin solution was discovered. In about the year 1630, Cornelius Drebbel observed by an accidental mixture the brilliancy which the solution of tin gave to the infusion of cochineal. He communicated this discovery to his son-in-law, Kuffelar, a dyer in Leyden. He improved upon the process, kept it a secret from his fellow workmen, and brought into vogue the color which bore his name."

A few years afterwards a German chemist found out the process and brought his secret to London about the year 1643. It was soon known and diffused over Europe, and

afterwards whenever a new dye drug was introduced, the solution of tin was always applied to it, and it became a standard mordant for the red dyewoods, such as Brazil woods, and even for logwood on cottons.

I cannot impress too strongly upon the mind of the dyer the necessity of adding the tin gradually or bit by bit, one piece just as the other is dissolved; and more especially in those solutions that have nitric acid in their composition. We know that this is not generally the case, but that one handful of tin is thrown into the acids at too irregular intervals of time. When the tin is added in this manner, the action becomes violent, the solution gets heated, the nitric acid is decomposed, ammonia is formed in the solution, and when it becomes cold, a quantity of peroxidized tin falls to the bottom in a sticky, silver-colored, gelatinous precipitate, creating a great loss; and the solution never will give a good clear hue to the color. The slower the tin is dissolved, the more permanent the solution and the brighter the colors.

TIN.

The principal places for obtaining tin are Cornwall, in England, Mexico, and the East Indies: in the former country the metal has been wrought for many ages.

In Cornwall the ore may be found in the veins of the primary rocks, also in small round grains near these rocks imbeded in what the geologists call the alluvial deposit, meaning the deposit formed by the washing away of the fragments of the primary rocks with water. This makes the best and purest tin, and is distinguished by the name of stream tin. The ore that is found in veins contains such metals as iron, copper, arsenic and the like, but is in part purified by roasting, and washing out the decomposed foreign substances, and then smelting it in a kind of cupola. That which con-

tains these impurities is called block tin. The pure grain tin is melted and let fall from a great height, which sort of splits it into bars or prisms as we find it in commerce. It is sometimes brought from England in large ingots, and then melted into small slender bars at the chemical works of this country; these bars when bent made a crackling sharp sound caused by a separation of their parts and the sudden fracture caused by bending. Good tin has nearly the color and lustre of silver; it entirely dissolves in aqua regia, (nitric and muriatic acids,) without leaving any dark colored sediment if it is pure. "Tin is known by the names of common tin, block tin, and grain tin. The first is tinned iron plates, and is used for making tin ware, block tin is used for making kettles, &c.; the grain tin is best, and the kind used by dyers in making their solutions of tin." To have a pure and first rate metal is of the utmost importance in making the different solutions of tin. "The specific gravity of tin is 7.298, its prime equivalent is 7.353, and its melting point is 442 degrees."

MURIATE OF TIN.

Muriatic acid will dissolve nearly one half its weight of tin, and it attacks it with a good deal of activity and disengages a quantity of mixed gases in which hydrogen may be easily distinguished. To make this solution you take two parts by weight of muriatic acid, and one part of tin, or give tin as long as the acid will dissolve it, following the direction given on page 69; after this is dissolved and has a few days age it will have an agreeable and fragrant smell, and a sparkling, glistening appearance, this is caused by a portion of it having crystallized and the crystals are floating in the solution. If this solution was evaporated by a gentle heat, the water of the solution would be driven off, and by cooling the whole would crystalize; this is the process of obtaining crystals of

tin, or crystalized muriate of tin, and contains three proportions of water or about 20 per cent. but according to investigations made by Dr. Penney, they contain only two proportions, or 14 per cent. of water.

MURIO-SULPHATE OF TIN.

Take two parts by weight of muriatic acid, and one part sulphuric acid, add to this last acid an equal weight of water and when it has cooled from the heat caused by mixing the water with the acid, then mix the two acids and add gradually one part of tin.

This solution is sometimes termed yellow spirits.

Some dyers in preparing or making this solution of tin use sal ammoniac instead of muriatic acid, but I do not think they can obtain so good yellows as they would if the muriatic acid was used. This solution will crystalize like the muriate of tin.

ANOTHER MURIO-SULPHATE OF TIN FOR LAC DYE.

Take five parts of muriatic acid, one part sulphuric acid and one part tin, (all by weight,) and proceed as with the preceding solution.

NITRO-MURIATE OF TIN.

A mixture of nitric and muriatic acid will dissolve about one half its whole weight of tin. To make this solution take four parts of nitric acid and three parts of muriatic acid, mix these together, then add one part of tin, (all by weight.)

This solution ought to show a fine opalous amber-yellow color, to be in the greatest perfection for coloring scarlet shades; but for yellows, crimson shades, etc., it may be of a browner yellow color, and be more highly charged with tin. Some dyers use but one part of nitric to three parts of muriatic acid, and add the tin until it ceases to dissolve it. This solution does well for a deep, heavy red, with camwood or Hypernic wood, but not for cochineal or lac. If they want a more crimson hue they use one part nitric and five parts muriatic acid, and two parts tin, a very good solution for any of the red woods.

Instead of using muriatic acid in the above solution, some dyers take six pounds of nitric acid to one pound of water in which has been dissolved one pound of sal-ammoniac, and then add ten ounces of tin. The solution of nitro-muriate of tin cannot be crystallized.

The solutions of tin are now seldom made in the dyehouse, but are purchased with the other dyestuffs.

We might give directions how to test the solutions of tin, but it would require too much time and trouble for most of us dyers, and as the solutions are pure enough for about every purpose for which we want them, we do not trouble ourselves about the impurities, or the amount of tin contained in the solution. Yet I would advise every dyer to make his own tin liquors, and then he will know how much tin is in his solutions, and can govern himself accordingly.

SCARLET SPIRITS.

This is the best tin solution for scarlets that I ever used, and is made as follows: Take four quarts of nitric acid, one quart of water, and one quart of muriate of tin. Mix these three articles together, then add 1½ ounces of tin to the pound of the mixture.

In dyeing, use as much of the above spirits as you do of muriate of tin: that is, supposing that you require two quarts of muriate of tin for the color, then use as much of the other along with it; otherwise one quart of each.

OXALIC ACID.

This acid was formerly known by the name of salts of sorrel. It was formerly obtained from a plant, but now it is manufactured from sugar and starch, by the action of nitric acid upon these two articles. To obtain this acid 1 part of sugar, 2 of starch, 4 of nitric acid, and 2 parts of water, are put into a retort. A violent action takes place; the nitric acid decomposes and oxidates the sugar and starch; red fumes are emitted, which mark the presence of nitrous acid; the liquid in the retort is evaporated to about two-thirds of the original bulk. White-colored crystals form as the solution cools. These crystals are again dissolved and evaporated again.

Oxalic acid combines with different bases and forms salts of various kinds that are of great importance in the laboratory. It is easily known from the alkaline or earthy salts, such as Epsom salts, (sulphate of magnesia) for which it has through ignorance been mistaken, they both having an acid character.

Oxalic acid often contains peroxide of nitrogen and Epsom salts. (Peroxide of nitrogen is destructive to animal and vegetable life, and will destroy all colors very rapidly when exposed to this element). To detect the presence of peroxide of nitrogen in this acid, dissolve a little oxalic acid; then add the smallest possible quantity of sulphate of indigo, and boil the solution. If nitrogen is present, the indigo will be discolored. If it contains Epsom salts, you can detect it by heating some of the acid to redness upon a piece of platinum, when it will all evaporate and leave no residue. But if it

contains no Epsom salts, it will leave a yellowish looking substance upon the platinum. There is often from one to three per cent. of Epsom salts in the commercial oxalic acid.

One part of bichromate of potash, two parts of binoxalate of potash, and two parts of oxalic acid will form a curious salt of a beautiful color, by dissolving these three substances together in boiling water. The effect of this combination is the formation of carbonic acid and a double salt of oxalate of potash and chrome, causing the solution to have a beautiful purple color. Then by evaporating this solution, you can obtain crystals of a very deep blue color, but of no use as a dye.

This acid is now used more than formerly, and can be used on more than one-half of the colors now dyed upon wool, as it will combine with all the dyewoods, and will add intensity to the color, besides giving it a more brilliant hue.

Oxalic acid is composed of carbon and oxygen, having a proportion of the second element between those contained in carbonic oxide and carbonic acid. It therefore contains 12 of carbon and 24 of oxygen, or 2 parts of carbon and 3 parts of oxygen.

BI-SULPHATE OF COPPER, OR BLUE VITRIOL.

Copper will combine with nearly all the acids, and when so combined the crystals are generally blue or green colored, sulphuric acid if cold will not dissolve it, but at a boiling heat it acts rapidly upon it; a portion of the sulphuric acid will suffer decomposition. Sulphate of copper yields blue crystals which contain about five parts of water, four of them will be given off if you heat the crystals to 212 degrees Fahrenheit, at this temperature they will become white. Sulphate of copper is soluble in twice its weight of boiling water and four times its weight of cold water. It is made from the sulphuret of copper, it is an ore of copper called

copper pyrites, also from sulphuric acid and old copper scraps: the acid is put into large stone tanks, and the scraps of copper thrown into this tank; after remaining there 24 or 36 hours they suspend strips of lead in the solution and the salt collects in crystals upon the lead, it is then broken off the lead, dried and packed in casks for the market. When made from pyrites or from the sulphuret, it is first roasted, then moistened with water, and treated similar to manufacturing of copperas. It is often contaminated with iron. This impurity can be detected by dissolving a piece of the sulphate in distilled water, then add ammonia in excess, then pass the solution through a filter, on washing the filter you will find the iron on the filter as a brown precipitate of peroxide of iron. If it contains much iron you should reject it. Zinc is sometimes present, but this does not have any bad effect further than to lessen its value. Sulphate of copper is known in the dye house as blue vitrol, Roman vitrol, blue stone, and bi-sulphate of (cupri) copper, and it is composed of sulphuric acid, 31.38; oxide of copper, 32.32; water, 36.-30, in 100 parts. Its specific gravity, 2.232, and its prime equivalent is, 31.250. The crystals effloresce in a dry atmosphere and it will become a white powder.

ARGOL.

"Crude super-tartrate of potash, or red tartar is deposited upon the sides of casks containing some kinds of wine, carrying into its crystallization some of the coloring matter of the peculiar kind of wine from which it was deposited; this is the reason of the difference in the color of argols. This crude tartar is employed by dyers in all common and dark colors where a super-tartrate of potash is required as an auxilliary to the mordant, it comes at a cheaper rate than the white cream of tartar, which is obtained from red tartar or argols, by precipitating or retaining its coloring matter with char-

coal, clay, &c." The only difference between cream of tartar and red tartar or argols is occasioned by the nature and quantity of coloring matter it contains. For dyeing any and all colors where tartar is required I prefer the red tartar above the cream or white tartar; I consider that it contains more pure tartar, and is not so liable to be adulterated on account of its low price, and there being no difference in the results from the two tartars induces me to make use of the red tartar instead of the white.

The properties and constitutions have been described under the heading of "Super-tartrate of Potash."

FERROCYANIDE OF POTASSIUM, OR YELLOW PRUSSIATE OF POTASH.

This salt is prepared by calcining together hoofs, horns, hides, old woolen rags and dried blood, or similar substances, with potash, in an iron vessel. As a general rule these substances are burnt in a cast-iron cylinder before being mixed with the potash. If these substances are used without being subjected to the above process, they are mixed in the ratio of 9 to 1 of soda-ash; but if burnt as above mentioned, one and a half of the charcoal is mixed with one of soda-ash. When the animal substances are used without the process of charring them, the calcining pot is left open, so that the materials can be stirred, and thus allow the obnoxious gases to escape, after which they close the vessel and increase the heat. This heat is continued for some fourteen hours, and at intervals of one hour they open the pot to stir the material within. They continue this operation until no flames rise to the surface, and the whole is reduced to a red semi-fluid mass. The whole mass is then scraped out with iron ladles and allowed to cool. It is dissolved in cold water, and evaporated to a proper consistency. Then coarse strings are suspended

throughout the liquid, and crystals of ferro-prussiate are formed in bunches upon these strings, of a fine yellow color.

It crystallizes with three proportions of water, but will lose its water at 212° of heat. It will dissolve in about four times its weight of cold and two times its weight of boiling water. Its specific gravity is 1.830. Its composition is: acid, 6.625; potash, 7.250; water, 2.255; and its prime equivalent, 16.125.

FERRICYANIDE OF POTASSIUM, OR RED PRUSSIATE OF POTASH.

This salt is made from the yellow prussiate by passing chlorine gas through a strong solution of yellow prussiate of potash until it changes to a reddish color, and forming chloride of potassium, a salt differing materially from yellow prussiate. This solution is evaporated, and crystallizes in beautiful ruby red crystals, and from its color is termed red prussiate of potash. I do not know its specific gravity. Its solubility is the same as the yellow prussiate.

If sulphuric acid is mixed with dry powdered prussiate, it deprives it of its color, but by absorption of moisture it returns to blue again.

BICHROMATE OF POTASH, OR CHROME.

This salt is made from yellow chromate which is prepared in the following manner:

"Chrome iron ore, after being ground and sifted, is mixed with dried nitrate and carbonate of potash. This mixture is put into a reverberating furnace and a powerful heat applied. It is stirred occasionally, and when perfectly calcined, the

mass is raked out and dissolved in water. It is then boiled for some hours. After it is done boiling it is allowed to settle, and the solution is decanted; this is evaporated and leaves the yellow chromate of potash crystallized.

"The chemical changes which take place in the furnace are these:

"First, the decomposition of the nitre, giving off oxygen, which combines with the oxide of chromium and forms chromic acid. This acid then unites with the potash of the nitrate and of the carbonate, and this forms the yellow salt, which is soluble in water. It contains soluble impurities, such as caustic potash, silicate, and aluminate of potash; these impurities are separated by the operation of boiling and crystallization.

"The bichromate is prepared from the yellow salt obtained as above. Into a concentrated solution of yellow chromate is poured acetic or sulphuric acid. The last named acid is not well adapted for the purpose, as the sulphate of potash formed by the sulphuric acid is very difficult to separate from the chromate, and is a serious adulteration; for which reason sulphuric acid is not now used as much as formerly. Acetic acid is the best and is now, as a general rule, employed.

"The amount of acid used is regulated so that it will combine with one-half of the potash there is in the yellow chromate, leaving two proportions of chromic acid in union with the other half. The solution of yellow chromate being concentrated before the addition of the acetic acid, the bichromate that is formed does not have as much water as will hold it in solution, therefore it is precipitated as an orange-colored powder. They carefully collect this powder, and it is again dissolved in water, and crystallized by slow evaporation."

Soda has been used in making this salt, to form a bichromate of soda, which might be useful to the dyer if it was not for the disposition that all the soda salts have to effloresce when exposed to the atmosphere.

Its specific gravity is 1.845; its composition: 43.70 ferrochyazic acid; 39.57 potash; 16.73 water, in 100 parts; or acid, 6.600; potash, 6.25; water, 2.250, making its prime equivalent 14.865. It is soluble in three times its weight in cold water and in an equal weight of boiling water.

PROTO-SULPHATE OF IRON OR COPPERAS.

This article is manufactured from iron pyrites (which is a bi-sulphuret of iron,) and contains 52 parts of sulphur and 48 parts of iron in 100 parts.

In the United States copperas is manufactured from a native sulphuret of iron. "The iron pyrites are placed upon an inclined platform, and water sprinkled upon them from time to time and as the water drains through them, it carries off a part of their substance, which has been rendered soluble by the water and action of the atmosphere having oxydized the sulphur and converted it into an ascidulous sulphate, the water after draining through the pyrites is received into stone cisterns." Owing to the excess of sulphur over the iron, there is in this solution an excess of acid, with more or less persalt of iron, and often small quantities of copper, which is objectionable. To get rid of this, old iron is put into the solution, which takes up the excess of acid and at the same time precipitates the copper from the solution, and reduces all the per-sulphate of iron to the state of proto-sulphate (which is copperas in a liquid state). The solution is then evaporated to a proper density and crystallized. This method of adding old iron to produce the above results, is not always adopted and is the reason of the different varieties of copperas found in the markets concerning which there

is much prejudice in the minds of dyers. M. Bansdorff, (*Records of General Science,*) states that there are three varieties of copperas, the first greenish blue, formed from an acid solution free from peroxide; the second, dirty green, from a neutral solution without peroxide; and the last, emerald green, from a solution impregnated with peroxide salt. Sulphate of iron crystallized from a neutral solution if kept anytime will have a rusty appearance by absorbing oxygen, and forming peroxide of iron. Good copperas having this rusty appearance especially on the top of the cask when it is opened, dyers entertain the opinion that it is to this redness that it owes its superior qualities. This is a great mistake in their opinions for Mr. Parks in his chemical essays says, that dealers knowing the opinions of dyers take the advantage of those dyers, by sprinkling lime on the top of the cask to peroxidize the surface, and make the dyer believe he has got hold of some *good old copperas.* Sulphate of iron is generally judged by its color, the worst kind of copperas has often a solution of common salt or of lime sprinkled upon it to give it a dark tint, this may deceive the eye but it does not improve the bad qualities of it.

English copperas is superior to the Scotch or the Vermont copperas, so called. The former is made from pyrites, but the Scotch is made from alum shale, and is very apt to contain sulphate of alumina; and being made from a strong solution of the sulphate of a salt of another metal, it has every chance to be inferior.

There is a copperas made in Worcester, Mass., called "Anderson's Pillar copperas," which is the best I ever used for coloring cotton blue (in the copperas vat), and according to analysis is the nearest to the chemically pure of either the English, Scotch, or Vermont copperas, and it costs but a mere trifle more a pound than the others; and I know by practical experience that for all purposes connected with dyeing it is the best and by far the cheapest copperas that any one can purchase. It contains more sulphate of iron than any other copperas in the market, as will be seen by the following anal-

ysis of the English, the Vermont, and the "Pillar," 100 parts of each:

	Pillar.	*Chemically pure.*	*English.*	*Vermont.*
Sulphuric acid,	29.14	28.77	23.95	30.54
Protoxide of Iron,	25.74	25.89	21.83	23.49
Peroxide of Iron,	1.07	.....	1.18	1.28
Oxide of Copper,	a trace,	.....	.....	1.51
Water,	44.05	45.34	53.04	43.18
	100	100	100	100

The specific gravity of a concentrated solution of the Pillar copperas is 1.850, while that of the English is 1.650, showing a difference of 0.200 in favor of the Pillar. Its prime equivalent is 22.675; that of the English is 21.870.

The result of three different tests and experiments that I have made with the Pillar and the Vermont copperas as to their relative value, is as 20 to 24, or 100 pounds of Pillar copperas are worth 118 pounds of the Vermont. In testing there is always an excess of acid. The quantity is not any thing like this difference, however.

Copperas is very soluble in water: 12 ounces of boiling water dissolves one pound of it, and cold water dissolves half of its weight. By exposure to air it attracts oxygen, and is converted into the yellow or red per-sulphate. In a dry atmosphere it parts with its water of crystallization, and becomes a dry powder; dissolve it in water again, and we find it to contain per-sulphate and proto-sulphate of iron.

SULPHATE OF INDIGO.

This article is a combination of sulphuric acid and indigo known by the different names of saxon blue, china blue, extract of indigo, and chemic. Dyers now days seldom make

their own sulphate of indigo, it is manufactured for them, and in the market it is sold under the name of extract of indigo. When dyers made sulphate themselves each one had a rule of his own, some using 4 pounds sulphuric acid to 1 pound of indigo, others 3 to 1, but the best combination in my opinion is 6 to 1, that is 6 pounds sulphuric acid to 1 pound indigo, especially for greens, but I should use even more acid than the above for coloring saxon blues. Every dyer should make his own sulphate, as he will then know the correct combinations of it, which he would not of that which he purchases in the market, besides it will not costs his employer as much as though he bought it already made, and the extract of commerce is adulterated more or less. It is manufactured in the following manner:

The indigo is dissolved in the sulphuric acid (different makers using different proportions,) it is then diluted with hot water, the whole is put upon a filter of woolen cloth, which separates the insoluble impurities of the indigo. The solution which has passed through the cloth is then put into a leaden vessel, and evaporated to about three gallons for every pound of indigo used. They then add from three to four pounds of salt to the pound of indigo, and well stirred up. It is thrown upon another filter of woolen cloth; the extract remains upon this filter until sufficiently drained, it is then ready for market. Some makers put soda and a little ammonia which gives the extract that bloomy appearance which we sometimes see. A pound of good indigo will yield fourteen pounds of extract if rightly managed in making. Some makers add lime to their extract to make it weigh more, but those who do so lose by it, for although the dyer may not have the means to test the extract, he very soon ascertains by experience its working value. The method that I use for making this article is as follows:

In the first place I endeavor to get the very best ground indigo, then dry it as much as possible by placing it either on top of the boiler or in the dry house. Then for every pound of indigo that I intend to use, I take 7 pounds of con-

centrated sulphuric acid using a glazed earthen jar, adding the indigo gradually (say about one half at a time,) stirring it all the time until all the indigo is moistened by the acid, then in the course of fifteen minutes add the rest of the indigo, stirring as before, and stir it during the day at intervals, do not use it until it is two or three days old. When you are making it do not set your jar in the dye house where it will absorb the steam and vapors from the various dye tubs. The jar should be kept covered and placed where the heat (caused by the combination of the acid and indigo,) may be kept at 160 degrees Fahrenheit. As the combination takes place, the compound will assume a frothy appearance, increase in volume, and a great deal of heat is generated, with the disengagement of a suffocating gas; these are the certain results of the combination, and when they have all ceased the chemical union is completed. Some times the temperature of the atmosphere may be so low, that the chemical action does not readily take place, in such cases dyers throw in a little chalk or soda-ash to excite the action of the acid and indigo, but this is a bad practice, for it only creates (by disengagement of the carbonic acid of the chalk or soda-ash) a motion among the particles of indigo and acid, and does not promote the chemical action, whereby the combination can be effected. If you cannot keep the heat up the best way is to place the jar in a vessel of hot water, which causes a reciprocal and true action to take place on the principle that some combinations are made at one temperature that could not be effected at another. The addition of chalk or soda-ash is rather injurious than otherwise, but I do not believe that we can find any of the sulphate of indigo that is in the market but what contains soda or potash. Sulphate of indigo does not give a permanent color, yet it can be made to resist the alkalies and fulling mill very well by mordanting (for greens see recipe) with bi-chromate of potash, alum and crystals of tin.

THE ACIDS.

"They are a very numerous, interesting and important class of substances, but in this work we will describe only such as the woolen dyer has to deal with, which are three in number, viz.: the sulphuric, nitric and muriatic acids.

"Acids are the antagonistic principles to alkalies; they neutralize alkalinity and form salts by their union with them; they combine with the earths also, and in general these compounds are soluble, but there are some that are not soluble. They act upon metals, oxidizing, combining with, and dissolving them, thus bringing the base of colors into a tangible form, so that the coloring principle will operate upon them. They will modify the shades of color, changing the purples to red or orange, and the reds to orange or yellow, making the yellows brighter, lighter and more lemon-colored in their shades.

"Thus we see the importance and necessity of their presence in the formation of colors. They do not injure wool much unless they are used in excess, or aided by a powerful heat, consequently woolen fabrics will bear a greater amount of acid than of alkali without injury to the fibre; but as they combine with the wool some, they may retard the fulling and scouring in a slight degree. The relative strength of these three acids, required to saturate an alkali and form compounds with an earth or metallic, are the following:

"Sulphuric acid (of specific gravity, 1.848) is 5; nitric acid (specific gravity, 1.500) is 6.75: muriatic acid (specific gravity, 1.200) is 4.60. Thus 5 of sulphuric acid, 6.75 of nitric acid, and 4.60 of muriatic acid, each neutralize 2.125 of ammoniacal gas, or 3.36 of aqua-ammonia, 4 of soda-ash, and 6 of potash."—*Gibson's "System and Science of Colors."*

SULPHURIC ACID.

This is one of the most important compounds of sulphur. It is not made by the direct action of its elements, but by the oxidation of sulphurous acid. It is also made by burning sulphur with about one-eighth its weight of nitrate of potash in large leaden chambers. On the bottom of these chambers is a layer of water to absorb the gas. The water is drawn off at short intervals as it becomes impregnated with the gas. These drawings off are so regulated that the specific gravity when it is drawn off is about 1.848. It is now considered concentrated sulphuric acid.

It can also be made by putting a quantity of proto-sulphate of iron into an earthen retort and applying heat to it. The sulphuric acid is distilled over and peroxide of iron remains. This is the oldest way of obtaining sulphuric acid, and they still practice it in some parts of Germany, especially in Nordhausen. It is very strong and of a dark color. This acid is the best kind for making sulphate of indigo.

Sulphuric acid has great attraction for moisture, so much so that if left exposed to the air it will become diluted. A cup half filled with it will get full in a few days by being exposed to the dyehouse atmosphere. This shows the need of keeping the carboys well stopped up. This applies to muriatic and nitric acids also, causing them to lose their strength by being left unstopped.

Sulphuric acid is a corrosive substance, converting animal and vegetable matter into charcoal, the hydrogen and nitrogen of these substances forming water which combines with the acid, which leaves the carbon as charcoal. It is the only liquid that will combine with and dissolve indigo without deoxidizing it. It combines intimately with water in any proportion, yet there seems to be certain definite quantities that will combine with it chemically. When water is added heat is evolved (this heat is a definite quantity), and is accompanied by great condensation of bulk, as the dyer can convince himself by taking equal quantities of strong vitriol and water

and mixing them; when the mixture is cold he will find a much less quantity. The heat of the above mixture when first put together will reach the boiling point, or 212 degrees.

Oil of vitriol or sulphuric acid combines with alkalies, earths and metals, and the salts thus formed are called sulphates of the particular base to which it is united, such as alum, copper, iron and lime. They are then called sulphate of alumina, sulphate of copper, sulphate of iron, sulphate of lime, sulphate of indigo.

Sulphuric acid is principally made use of by the dyer for making sulphate of indigo (or chemic), and with muriatic acid as a solvent for tin in making the solution of murio-sulphate of tin, as a mordant for scarlet, yellow, etc. Its specific gravity is 1.848 (if the hydrometer gives 100°). At 95° its specific gravity is 1.833.

NITRIC ACID.

This is an acid that abundantly exists in nature in combination with other substances forming nitrates. It is manufactured from nitrate of potash or nitrate of soda. When made of nitrate of potash they use two parts of nitrate of potash to one part of sulphuric acid. These materials are put into an iron retort and a fire built under it, and the acid vapors which are distilled over are conveyed to an apparatus for condensing it, through glazed earthen pipes.

Pure nitric acid is clear and limpid, and in its most concentrated state its specific will be 1.500. Its color is a light brown, caused by having a little peroxide of nitrogen in it. It is often contaminated with iron from the retorts, and also with sulphuric and muriatic acid, common salt and other impurities in the nitrate used. They purify it from these impurities by re-distilling it in glass retorts.

In its action upon animal substances it colors them yellow, and converts them into oxalic, carbonic and other acids, and

should be always used with great care. It should be kept in a cool, dry and dark place, as light affects it as well as air. The sun's rays change the color by decomposing the acid and setting free peroxide of nitrogen, which will remain dissolved in the acid. A little oxygen gas at the same time is evolved, and if the carboy is stopped up tight, will either drive out the stopper or burst the carboy, a fact too often demonstrated.

Nitric acid is now made in great quantities from nitrate of soda (being cheaper than nitrate of potash), it having a lower combining equivalent, more nitric acid can be obtained from a given weight than from the same weight of nitrate of potash. Nitrate of potash will give 68 pounds of acid for the 100 pounds. Nitrate of soda will give 82 pounds to the 100 pounds, and does not require as much sulphuric acid as the potash does.

Nitric acid forms salts with alkalies, earths and metals, and exists in all compounds called nitrates.

MURIATIC ACID.

Muriatic acid has been known from an early period in history by the name of marine acid, spirits of salt, etc. Its constituents are chlorine and hydrogen, and is easily obtained by the action of sulphuric acid on muriate of soda in a furnace, by expelling the gas evolved into water in an arrangement of vessels called a wolf's apparatus. Water will absorb about 480 times its volume of the gas thus expelled, and its bulk will be increased about one-half, and its specific gravity will rise from 1.000 to 1.210. It is then a concentrated muriatic acid. The usual specific gravity of the muriatic acid of commerce is about 1.160, and has a pale straw color, and a strong smell. It is a colorless acid when pure, but a strong light turns it a yellow color.

This acid corrodes any substance that it comes in contact with, and destroys colors exposed to its fumes. For the above reasons it should be kept in a dark place, and well stopped up.

The impurities of this acid are iron, sulphuric and sulphurous acids. The iron can be detected by using a little diluted acid with a drop of gallic acid. The tests of the other impurities are too tedious to adopt.

The chief use that woolen dyers make of muriatic acid is as a solvent for tin; it enters into the composition of the nitro-muriate, muriate and murio-sulphate of tin. It holds a larger quantity of tin in solution than any other acid, for which reason we see the importance of having a certain portion of tin visible in the solutions, especially in the muriate of tin solution.

PART SECOND.

THE PRINCIPLE AND PRACTICE

OF

Woolen Dyeing,

WITH

RECIPES AND SAMPLES OF COLORS.

WOOL SCOURING.

It is a common and almost universal practice among dyers not to be as particular in having their wool scoured for the dark colors as they do for the light shades or for the blue vat. This I think a very erroneous idea, and I cannot see any reason for such a distinction ; but I say that the wool can never be got too clean, and I wish to impress this forcibly upon the attention both of the manufacturer and dyer, that for all and every color be sure to have the wool clean. Suppose we do not get the wool clean, let us follow it from the dye house to the finishing room. In the first place if the natural grease of the wool has not been sufficiently started in the scour kettle, all the water you can use will not free that wool from the grease thus set or fixed, and you will find that it feels greasy and sticky to your hands. We now proceed to color it some common color, say black, olive or drab. It is true the color may look tolerable well but let us follow it through the different processes of manufacturing. In the first place it will card badly and require more oil than clean wool, in order to overcome the adhesiveness of the greasy paste left upon it before it was colored; it makes considerable more waste than ordinarily, which will be a great loss; it spins bad, breaking and not drawing out or making as fine, even or strong yarn as it otherwise would do; it does not weave so well either. But we now come to a process that it must go through where we shall find the worst effects of bad wool scouring, and that is the operation of scouring and fulling the cloth ; the cloth can scarcely if ever be scoured clean, and if it should be got clean it is done only by repeated scourings or by employing a soap or scour liquor of an alkaline strength so excessive as not only to injure the texture and fulling property of the cloth, but almost to destroy the

color, which will look dull, lifeless and poor; the cloth of itself will have a dead, lusterless appearance. The consequence is, such goods go to the market and sustain a loss proportionate to the above defects in their manufacture.

The above disadvantages in not having the wool clean are sufficient without naming any others, to prove the necessity of having the wool perfectly clean before it leaves the dye-house or the dyer attempts to color it, and he will see also how essential it is to his interest for him to have a perfectly clean ground on which to make his colors; for upon unclean wool he cannot expect to have his colors look bright, or have them permanent. But if the wool is clean the colors will be bright, and every subsequent operation of manufacturing will have a tendency to improve the beauty and lustre of the colors and fabric.

Wool can be colored in a permanent manner without being scoured at all, and it works in every respect well, with the only exception of filling up the cards and making more work for the carder, as he will have to clean the cards oftener. It spins better, and the cloth will full and scour easier and better than if the wool had been scoured. In this case the natural or animal grease of the wool is in a free and natural state, no alkali being in combination with it; so the mordant employed in coloring is not decomposed by it, no more than clear oil would be when it is poured into a solution of any metallic salt in water.

It would be better to color the wool without scouring than to color it when it is but half scoured; so it is very necessary that we should begin right (by having the wool clean), so as to have a clear foundation, and leaving nothing that can afford the least resistance to the free action of the dyestuffs upon the wool; for on the mutual and intimate combination of the dyestuffs depend the permanency and beauty of all colors.

Every dyer, as a general thing, has his own particular method for scouring the wool, some using soda-ash and salt, others, sal-ammoniac and the different patent wool cleansing

ingredients. Therefore I will not dictate them in the matter, but will say no matter how or by what process you scour the wool, only do not use alkali of such strong properties as to have the wool feel harsh and sticky (or as some say, *clammy*), but have it feel soft and buoyant, and when shook up it will fall apart loose, and have no smell of the sheep about it.

EXPLANATION OF THE RECIPES.

Each of the recipes is given for the quantity of wool mentioned. The number of pounds means wool before it is scoured (or wool in the grease). The samples are numbered in each order of color to correspond with the recipe by which they were colored. There will be recipes to color the same shade by different processes: that is, by preparing the wool first, and giving it the coloring matter afterwards, and by giving the coloring matter first, and then the mordant after (saddening). There will be no recipes inserted but such as I have colored with and can recommend and warrant to produce good results.

I have, as a general thing, given the common names of the ingredients used, instead of their botanical or chemical names. If given by the latter names you will find them explained in the "Glossary of Technical Terms and Chemical Names." You will find remarks attached to such of them as require any deviation from the usual practice or mode of dyeing.

ORDER YELLOW.

The substances that furnish the coloring matter in the most abundant quantity are fustic, sumach, quercitron bark and flavine; for which reason I have only given recipes for coloring yellow with the above materials, as they are the kind

most commonly used at the present time in woolen dyeing, and give a brighter and more permanent color than tumeric, weld or woald, or heath. The coloring matter from all these substances, with reagents, produce the following results:

All the acids will brighten up their solutions, causing them to assume a deep lemon shade. Alkalies will deepen them and turn them to an orange shade. Alum gives a greenish yellow shade. The different solutions of tin will give a deep and decided yellow.

For further information, see description of the above dye-stuffs. The mordants mostly used for yellows are alum, tartar, and the solutions of tin.

Care should be taken to have every thing about the dye tub as clean as possible, and to have the solutions clear and limpid. When using quercitron bark, do not boil it to extract the coloring matter, but rather steep it out, as it will give brighter colors if not boiled.

RECIPES FOR YELLOW.

Fustic Yellow.

For listing or mixtures, a very permanent color.

No. 1.	375	pounds	Wool.
	15	"	Potash Sulphate Alumina.
	7	"	Super-tartrate of Potash.
	5	"	Muriate of Tin.
Finish with	70	"	Fustic, boil one hour.

Bark Yellow.

No. 2.	420	pounds	Wool.
	60	"	Quercitron Bark.
	8	"	Potash Sulphate Alumina.
	7	"	Super-Tartrate of Potash.
	6	quarts	Muriate of Tin.

Canary Color.

No. 3. 200 pounds Wool.
7 " Quercitron Bark.
7 " Potash Sulphate Alumina.
7 " Super-Tartrate of Potash.
1 quart Muriate of Tin.

Use these all together and pole well for three-fourths of an hour, at 200 degrees but do not boil.

Another Canary.

300 pounds Wool.
5 1-2 " Flavine.
2 1-2 " Potash Sulphate Alumina.
7 1-2 " Muriate of Tin.

Pole well for half an hour, boiling the wool gently during the time.

Sulphur.

250 pounds Wool.
6 " Quercitron Bark.
5 " Potash Sulphate Alumina.
7 " Super-Tartrate of Potash.
5 " Sulpho Muriate of Tin.

Give a very little sulphate of indigo just enough to give a tinge of green due to the color of sulphur. Boil the wool one hour. Wash off all these colors as soon as possible after coloring them.

Fustic Yellow.

200 pounds Coarse Wool.
60 " Fustic.
6 " Red Tartar.
12 " Alum.
2 quarts Murio-Sulphate of Tin.

After boiling out the fustic, dissolve the salts and turn them into the kettle; then turn in the tin solution, stir it up well, enter the wool, and boil one hour; take out and wash off the wool. This color was for listing.

Gold Color.

225	pounds	Wool.
75	"	Quercitron Bark.
15	"	Alum.
7	"	Red Tartar.
7	pints	Murio-Sulphate of Tin.
6	ounces	Cochineal.

Proceed in all respects as the above.

Another Yellow.

200	pounds	First Wool.
5	"	Flavine.
8	"	Alum.
3	quarts	Muriate of Tin.

Boil the wool one hour. Proceed as above.

ORDER RED.

The substances that give us the coloring principle for this order of colors are not so abundant as those substances or materials that give us the yellow coloring principle. Those materials that give us the red coloring principle, being productions of the temperate portions of the earth, of vegetable and animal origin, and being also productions of the warm latitudes, we are to infer from this that it will require more of the sun's rays or action to produce the red and bring it to maturity than it does the yellow coloring principle.

The colors produced by most of these substances are of a permanent character. Those colors made from madder, lac dye and cochineal are nearly as durable as those made from indigo. Cochineal and lac dye, along with the different solutions of tin, will give the most superb colors, only equalled by those produced by the aniline dyes. The different kinds of madder will give us a common red, that is, in its crude or rough state. We can produce a scarlet from the extract of madder (or purpurine) nearly or quite equal to cochineal scarlet, and exceeds it in permanence. Peachwood, Hypernic and other red woods will give a good common red, but are fugitive. The mordants for these woods are super-tartrate of potash and alum only.

REDS.

In coloring these colors, a great deal of the effect depends upon cleanliness, and care to have all the solutions clear, the alum, &c., as well as the rest of the dyestuffs of a good quality and free from adulteration.

After they are colored have them washed off and dry them out doors if practicable, except those that are colored with hypernic, &c., which will be better to dry in the shade.

RECIPES FOR REDS.

Crimson.

No. 1.	300	pounds	Wool.
	20	"	Ammoniated Cochineal.
	12	"	Potash Sulphate Alumina.
	12	"	Super-tartrate of Potash.
	6	quarts	Nitro-muriate of Tin.

Boil the wool one-half hour. Ammoniated cochineal is made by digesting the cochineal with an equal amount of ammonia, and let it be at least one day old before using it, and keep the air from it, as it will evaporate.

Scarlet.

No. 2.	125	pounds	Foreign Wool.
	15	"	Cochineal.
	4	"	Flavine.
	12	"	Red Tartar.
	4	quarts	Nitro-muriate of Tin.

Boil one and one-half hours.

Another Scarlet.

No. 3.	400	pounds	Wool.
	20	"	Fustic.
	7	"	Cochineal.
	9	"	Red Tartar.
	3	pints	Nitro-muriate of Tin.

Boil one hour.

Dyeing Process—Fresh Bath.

15	pounds	Cochineal.
7	"	Red Tartar (Argols).
5	quarts	Nitro-muriate of Tin.

Boil one hour; wash off.

Geranium.

No. 4.	300	pounds	Texas Wool.
	5	"	Potash Sulphate Alumina.
	12	"	Red Tartar.
	14	"	Ammoniated Cochineal.
	1	quart	Nitro-muriate of Tin.

Boil one hour; wash off.

Burns' Orange.

No. 5.	400	pounds	Wool.
	30	"	Fustic, (or 5 pounds Flavine.)
	24	"	Lac Dye.

15 pounds Red Tartar.
1 quart Muriate of Tin.

Boil one hour; wash off.

Hypernic Red.

400 pounds Wool.

Mordant Process.

4 pounds Bichromate of Potash.
8 " Potash Sulphate Alumina.
½ " Crystals of Tin.
½ pint Sulphuric Acid.

Boil one and one-half hours.

Dyeing Process.

120 pounds Hypernic Wood.
3 " Logwood.

Boil one hour; let it remain in the liquor four hours before drawing it off.

Madder Red.

300 pounds Fleece.

Preparation.

20 pounds Potash Sulphate Alumina.
10 " Super-tartrate of Potash.

Boil one and one-half hours.

Dyeing Process.

90 pounds Madder.
20 " Peachwood.
2 quarts Muriate of Tin.

Boil one and one-half hours; leave the wool in for four or five hours. A fuller and richer color can be got by adding to the above in the dyeing process 7 pounds Tartar, 25 pounds Lac Dye, and one quart more of Muriate of Tin.

Lac Scarlet.

250 pounds Third Fleece.
50 " Lac Dye.
10 quarts Nitro-muriate of Tin.
20 pounds Super-tartrate of Potash.
10 " Fustic.

Boil the wool one and one-half hours, then wash it off well.

Crimson.

For double and twist goods.

300 pounds Fourth Fleece Wool.

Preparation.

25 pounds Alum.
20 " Red Tartar.

Boil one and one-half hours.

Dyeing Process.

28 pounds Lac Dye.
10 " Cudbear.

Boil the wool one and one-half hours. This is perfectly fast.

Peachwood Red.

500 pounds, Third Fleece Wool.

Preparation.

50 pounds Alum.
10 " Bi-Sulphate of Copper.
3 " Oxalic Acid.

Boil the wool one and one-half hours.

Dyeing Process.

200 pounds Hypernic Wood.
2 " Calcium, (Lime.)

Boil the wool one and one-half hours. Do not put the lime into the bath until the bags containing the hypernic are withdrawn.

Another Red, but of a Bluer Cast.

125 pounds Wool.

Preparation.

18 pounds Alum.
4 " Blue Vitrol.
4 " Red Tartar.

Dyeing Process.

85 pounds Hypernic Wood.
1 pound Calcium, (Lime.)

Proceed in all respects as with the above Peachwood red recipe.

ORDER BLUE.

WOADED OR INDIGO BLUE.

"This is one of the fastest colors that the dyer can produce. It is also the softest in its action upon the wool, which it softens and feeds; it improves the quality of the wool very much; it is easier to work through the different operations of manufacturing than any other color; a good woaded blue will work milder and better than white wool." "These good qualities are all due to the woad as the principal agent in this mode of dyeing."

The manner of conducting or working a woad vat I have taken from my father's method with slight alterations, but every dyer will have his own way of conducting them and thinks his way the *very best* way. The observations herein made are not to stimulate the inexperienced to attempt to run a woad vat, but only to give a general outline of the usual manner of setting and working a woad vat, in order that those who never had an opportunity of observing the practice can form some kind of an idea respecting the way of working one.

WOADED BLUE.

The usual manner of setting a blue vat of the usual size (6 feet in diameter by 7 feet in depth) is to throw in from 400 to 500 pounds of woad. If the woad is dry and hard you cut it up as well as it can be done with a shovel; then fill the vat about half full of water, turn on the steam until the liquor is heated to 170 degrees Fahrenheit, let it soak all night, which will soften and help it to dissolve; in the course of the day have it raked up powerfully at intervals until you get the woad reduced into a pulpy state, and no lumps remain unbroken. About 3 o'clock in the afternoon fill up the vat with water to within six or eight inches of the top. If this reduces the heat of the solution below 150 degrees, then put on the steam until you bring it to 150 or 160 degrees; then add the following articles: good Dutch madder, 20 pounds; wheat bran, one-half bushel; Bengal indigo, 60 pounds (if for full blues, otherwise, 45 pounds); hydrate of lime, or ware, 15 or 20 pounds, (see article Lime in this work) nicely slacked and sifted. Then rake up powerfully for an hour, or until these materials are thoroughly incorporated, cover up the vat for the night and spread some sheets or wool bags over the cover, so as to retain the heat as much as possible. Look at the vat the first thing in the morning; cast your eyes over the surface and see if there are not some bubbles standing about the top; take some of them up with your fingers and you will observe that they are tougher than those that form upon water. See if there is not upon the smooth surface of the liquor a thin film, of a blue purple shade, that you can skim off with your finger nail. Take a stick or your hand and switch it about in the solution, so as to raise some bubbles or froth; take some of them up between your fingers, then spread out your fingers and see if they remain full and do not break easily. Take the vat dish and dip up some of the liquor and turn it over the edge of the dish slowly into the vat again, and while doing this look through the liquor, which should have a green or olive color.

After you have made this examination and found that the vat has these characteristics, it shows that the indigo has sprung, or a portion of the indigo is deoxidized, and now needs some lime to bring the indigo into solution. Give it at this time seven or eight pounds of ware, then rake it slowly and gently and cover it up for two hours; then look at it again and dip a lock of clean wool into it; let it remain in for fifteen or twenty minutes. This should be a yellowish green when it comes out, and will take about five minutes to un-green or become entirely blue. (Lay this lock of wool aside to compare with the next sample). In two hours more examine your vat again and you will see an increase of bubbles, and a good flurree has formed, and it lies well to the back side of the vat, and has got more consistency and feels sadder than it did at the other raking. It will look of a richer color; the scum of indigo upon the surface is thicker and more coppery colored. You will see green veins or waves when you move the liquor with your hands or a dish.

The vat is now what dyers term opening. Examine it with the dish as before, and you can see that the solution is a yellower green or olive in its appearance than before, showing a further deoxidation of the indigo, and the need of more alkali. Give it eight pounds of lime (ware), and rake it up as before; cover it up and let it stand three hours, then take another lock of clean wool and proceed with it as with the first lock, and when it comes out it should be a deeper shade, and be more of a grass-green color than the first lock, and it will take longer to ungreen. It will then be almost a middle blue in depth of color. If you will compare this with your first sample, you will see that it is a deeper and clearer blue than the first. This shows that the vat is doing well, although a little short of ware. The smooth part of the vat shows an improved condition; the scum looks richer and more glossy, and if you blow upon it you will see the scum of indigo open in a circle, and the clear liquor beneath will be a yellowish green color, and the circle will close up again when you stop blowing. Agitate the surface with your

hand, and the veins or wavy shades of color will be a livelier and yellower green than they were at the other examinations. The waves spread wider and roll about much longer, and the color will show more on your hands. The flurree on the vat is much more in quantity, and looms well up on the back part of the vat and occupies more space than it did before. The bubbles are larger and of a fine indigo-blue color. Serve it with six or seven pounds of ware, rake it up well, and let it rest four hours; then look at it again, and hang another lock of wool in the vat for ten or fifteen minutes or longer. When you take it out it should be a deep rich green color; in about five minutes it will be a bright, even middle blue, with a purple tinge to it. If this green should pass to a pale grayish blue in two or three minutes, it is a certain criterion that the vat is hard: that is, it has got too much ware; or if it should remain green after exposing it to the air for fifteen or twenty minutes, it shows that it is short of ware, or the vat is soft. Now blow upon the smooth surface of the vat and a circle of an inch or two in diameter will open, showing the liquor of a rich gold color, or in some cases, a rich yellowish green. When you stop blowing the circle will gradually close again, and will immediately cover with a blue film. The bubbles have increased and are of a different complexion, being a beautiful indigo color and some of them as large as a hen's egg. They will not easily break or collapse when you move them. When moving the clear surface with your hand or the dish, the film of re-oxidized indigo will run off towards the back of the vat and join the flurree, appearing like changeable silk, and will throw off all the shades of indigo, from the richest purple to the lightest blue.

On dipping the dish into the vat with the edge down and raising it up the liquor will hang to the edge of it like syrup and will have a fragrant and agreeable smell. The vat now presents a beautiful appearance, and all the indications are that it has received its compliment of ware, and is now in first rate order to commence coloring in it. Sometimes there

are cases where a vat will require more and sometimes less ware than the amount given, as the woad will vary in strength, some woad having more lime in it than others, but as a general rule it will take from 30 to 40 pounds of lime for 500 pounds of woad. (See article woad.)

By following the directions here laid down, and the materials being of the best quality, all these changes and appearances are sure to take place, and the progress of the vat will be as certain as this description has represented it to be, so that in nine cases out of ten you can bring it to work the next day after it is set, and can color in it on the day following. Be sure that you do not let the temperature fall below 135 degrees during any time, as that is about the right heat to color by, although I have worked a vat at a greater heat, but do not approve of it.

THE MANNER OF CONDUCTING A WOAD VAT FROM DAY TO DAY WHEN COLORING IN IT.

For a vat of the size specified in the preceding pages, take 75 pounds of well scoured wool, shake up by the side of the vat so that it will be loose and buoyant, having no lumps or matted locks among it, so that it can take the color evenly and all alike. After this is done uncover the vat and skim off the flurree into a pail, so that you may turn it back into the vat after finishing your day's coloring. Put in your trammel and net, then throw in the wool as quick as possible, getting it under the liquor as soon as you can, then handle it with the stick until the whole is even, and continue to stir it for an hour; then take it up and after letting it drain sufficiently, throw it upon the floor and shake it all over, so that it may ungreen as quick as possible. Take a sample of this wool and compare it with the one you are coloring to, and see whether you can bring it to the shade required without

raking the vat. If you think you can, put it in again; if not, rake the vat up and let it rest two or three hours, and proceed as before, only do not allow the wool to stay in any longer than to bring the color to the shade you desire. When you take out the wool shake it over as before, and when it is fairly ungreened wash it off. Give the vat at this time about five pounds of ware, rake it up well and cover up.

Have all this done by 3 or 4 o'clock in the afternoon, so that the vat may have time to rest and clear itself before you rake again, say at 7 o'clock in the evening, which will give you an opportunity of judging of the exact condition of the vat, whether it is in want of more ware, or whether it has too much of it. After you have raked up the vat, if the heat is not up to 135 degrees, put on the steam until it attains that heat, as that is the best temperature for working, although some dyers do not heat their vats over 130 degrees. At 7 o'clock or before, go and examine your vat, see if the liquor is clear and hangs like syrup from the edge of the dish, notice the top, and see if the flurree hangs well to the back side of the vat, and if the smooth surface of the liquor looks glossy, and whether it opens and shuts gradually when you blow into it, as described in the directions for bringing a vat to its working condition. On smelling at the edge of the dish, if it has got too much ware in, it will smell of lime, if not enough, it will smell vapid and soft. If the latter, give it four or five pounds of ware. In the former case give five or six pounds of madder and about eight quarts of bran, then rake up well. If the vat is rightly balanced with lime it will have a fragrant and agreeable smell. On the day following take the same amount of wool and proceed in the same manner, and give the vat from three to six pounds of ware after coloring. This is about the quantity it will require for each day's coloring afterwards, with very few exceptions.

After working the vat three days it will have to be replenished with indigo to keep it up to the strength it was when first set, this you must do after you have finished coloring in the afternoon on taking out your last dip, giving it as much

indigo as you think you have taken out in the three days' coloring, and when you wish to work it out in order to set anew leave off putting in indigo. When you serve with indigo give it at the same time 8 pounds of madder, 4 quarts of bran and 5 pounds of ware, rake it up well, and in the evening, (7 o'clock,) or after it has rested three hours, examine the vat as usual and if it has not *sprung* its indigo, give it madder and bran, or ware, as the case may be, and rake up well. Perhaps a good raking may answer this time without serving with anything, your own judgment and experience must decide this according to the appearance of the vat. A great many good blue dyers will serve with indigo every day, some every two days, and others have no stated periods; all have their own notions in this respect; I do not think it is of much consequence which of these ways you take only keep up the indigo as when first set, but I would advise you to serve with indigo, &c., as stated above, every Wednesday and Saturday afternoons. It is the usual practice with dyers to heat up their vats on Saturday afternoons, so that the heat will be about 130 degrees on Monday morning, so as not to have to heat up on Sunday, but it is a poor rule because you have to give it an excess of heat on Saturday in order for it to be the right temperature on Monday for working; where you heat a vat up above its ordinary degree you cause the fermentive properties of the woad, madder, and bran to be more energetic and therefore you must give it more ware to check it, than would otherwise be necessary. If to avoid attending to the vat on Sunday, we give it an excess of heat on Saturday we injure it more or less, as a vat will work the easiest and the most profitable to the manufacturer by keeping it at a uniform heat; on this account it is absolutely necessary to attend to the vat on the Sabbath, raising the heat to the right point and giving or serving it with such materials as it may require, in order to have it perform the next week's work without injury to it. If you attend to getting the vat in first rate condition on the Sabbath you will give it an impetus that will last during the week,

and it will not be liable to get much out of order before the next Sabbath, when you will again have a chance to give it another waking up that will last for the next six days. I do not think it is profitable to work a vat over three or four months at the most, as the colors are not so good or permanent when the vats get old, and there is a greater loss of indigo in the fulling and scouring than when colored in vats that are not so old, although I have worked vats six and even eight months without resetting, but it was where flannels only were colored.

The reader will perceive by this description that I have only conducted him through the operations of setting and working a vat where everything has gone on in a straightforward manner and with perfect success, because we have had the best of materials to work with (which should invariably be the case,) and have been treating it in a chemical and workmanlike manner, and as men understanding the business in which we were engaged both theoretically and practically, and knowing beforehand the certain results of every material we employed and every movement we made.

The reader must know that a description of this kind upon this important and complicated department of dyeing is of more real value than a volume of observations on the methods of getting a vat right after allowing it to get wrong by an injudicious and unskillful mode of treatment. It would be almost impossible to give any directions how to bring a vat about again after it is once wrong, other than those given in the preceding pages, for there are numberless appearances of the vat and of the wool which if closely observed by the dyer will give him a certain knowledge of the precise state of his vat, and will suggest to him the right materials it is most in want of.

By consulting the remarks made upon madder, bran, lime, woad, and fermentation found in this volume you may obtain additional information on these subjects.—"*Gibson's System and Science of Colors.*"

FERMENTATION, OR THE OPERATION OF WOAD IN THE BLUE VAT.

"We have shown in describing the couching or curing of woad (see article Woad) that it was brought by that process into such a state as to have a continual tendency to the production of ammonia, or into a substance whose fermentation commences in the alkaline stage. The soluble substances present in woad are chiefly mucilaginous and extractive matter, albumen, and a little saccharine matter. The albumen furnishes (independent of absorption from the atmosphere) the azote necessary to the formation of the ammonia which it creates and evolves during its fermentation.

"The woad vat is put together at a temperature of 170 degrees, and the materials that compose it are woad, madder, bran, lime and indigo. When in the course of ten or fourteen hours, chemical action has taken place, because we perceive a change in the appearance of the solution, which shows that the operation of the materials has commenced.

"We have now to ascertain what part each of the articles perform, and what is the nature of their operation. In the first place, the solution of the indigo is the object we wish to attain. When we put the vat together, therefore, that article is the one to be operated upon by the other articles in the vat, and in order to bring the indigo into solution, it must be brought into a state of oxidation, and then an alkali must be present, or it will not dissolve in water. The most important functions of the vat are to absorb oxygen and produce alkali; and as the proportions of the ultimate constituents of woad will be as 4 hydrogen, 3 azote, 2 carbon, 1 oxygen (as in the alkaline stage), all in a free and uncombined state, and carbon having a stronger affinity for oxygen than for any other substance — hydrogen and azote being inclined to unite — the effects of these compound affinities will be to produce simultaneously carbonic acid and ammonia; but, as the proportion of carbon exceeds the oxygen (in the woad),

and the indigo, holding oxygen by a weaker affinity, gives it up to the carbon (creating carbonic acid), the indigo is de-oxidized and will now dissolve in alkali.

"The ammonia and carbonic acid thus formed must, from their natures, reciprocally neutralize each other and create a carbonate of ammonia; and, as de-oxidized indigo will not dissolve in the solution of a neutral salt, it is evident that we must get rid of the carbonic acid before we can avail ourselves of the alkaline properties of the ammonia as a solvent of the indigo. To do this we give hydrate of lime (ware), which unites with the carbonic acid; then both become an insoluble carbonate of lime. The ammonia is liberated, and then the indigo dissolves in it.

"If we should use nothing but indigo and woad, the vat would in time de-oxidize and dissolve the indigo; but, in order to facilitate and give more energy to the fermentation, we give it madder and bran, which, having considerable saccharine and farinaceous matter, may be considered as given for the same reasons as yeast or barm is added to a solution of sugar, viz.: to start the fermentation of the materials in all their parts at once. There is nothing like yeast or molasses to start the fermentation of a woad vat and give energy to its materials when the fermentation has stopped, by having worked the vat too much, or for other causes, such as over-charging it with ware, etc.

"When a vat is first put together in the usual way an alcoholic fermentation commences among the sweet matters contained in the woad, madder and bran, that de-oxidizes the indigo and forms carbonic acid, and the woad yields ammonia at the same time; but as this acid and alkali rapidly unite, forming a salt which will not dissolve indigo, and the quantity of carbonic acid formed is more than the ammonia, we then give lime to saturate the acid; then the ammonia becomes free and dissolves some of the indigo. The process now goes on as before, and after a while the carbonic acid again obtains the ascendancy and another quantity of lime is given. The ammonia is again set free and more of the indigo is dissolved.

This waiting for carbonic acid to form and serving with lime is continued in until the production of acid and alkali are balanced and all the indigo is brought into solution. But if we should give too great a quantity of lime before the formation of any carbonic acid, we throw the vat back and arrest the further progress of the operation. If this happens we are obliged to give it a supply of bran and madder to start the fermentation again, or else wait until the woad urges on the fermentation. And if we should not serve it with lime at the right time the carbonic acid will overpower the volatile alkali, and if allowed to proceed, the ammoniacal odor ceases, the indigo becomes precipitated, and the vat is in danger.

"When the process of setting the vat has been rightly conducted and fairly balanced, the indigo all brought into solution, you can then safely commence coloring in it. By coloring (or dipping twice a day) in the vat, the liquor is exposed to the atmosphere, and in consequence, a quantity of oxygen will be absorbed by the indigo, which imparts carbon to the woad, creating carbonic acid, which requires a portion of lime to saturate it. So we see that it is necessary to give the vat lime every day after coloring in it.

"If, in our daily serving of the vat with lime, we should give too great a quantity of it, we stop the de-oxidation of the indigo (as the overcharge of lime prevents the formation of carbonic acid), the smell of the vat becomes caustic, the liquor is dark colored, the woad is blackened by the indigo that is precipitated; it becomes heavy and tough to rake, and if we should dip wool in it, the color would be grayish and a thin, feeble shade. If by repeated servings of lime we have got the vat (as dyers term it) hard, and it is impossible to get a good color out of it, because all the indigo is precipitated, the ammonia has evaporated, the liquor looks dark, the smell is like new slacked lime, the alkaline fermentation and the production of carbonic acid have ceased; and when you have got a vat into such a situation it is a job to neutralize the excess of lime and again raise the fermentation.

Then, if we by neglecting to serve it with lime, leave

it short of the quantity required to saturate the daily production of carbonic acid, then the trouble increases; the ammonia of the woad is overpowered by the carbonic acid, it will color the wool a pale, greenish yellow that will not become a distinct blue when exposed to the atmosphere. "The odor of the vat will be soft and sweetish, then flat and vapid, the liquor and sediment are greenish, or yellow colored, the bottom is loose and buoyant, the vat then is in a critical situation and needs serving with lime as soon as possible, in order to keep it from the putrefactive state of fermentation. These are the explanations of the phenomena of a woad vat, and are summed up as follows :"

"That the use of madder, bran, woad and lime, are to effect the solution of indigo in water.

"That the madder and bran act as a ferment, and create fermentation.

"That the fermentation of woad is a double operation, producing carbonic acid and ammonia, when uniting form carbonate of ammonia, and as the carbonic acid forms, the indigo is deoxidized.

"That the lime decomposes the carbonate of ammonia, the carbonic acid is precipitated, leaving the ammonia free, which disolves the de-oxidized indigo. "The formation of carbonic acid is required to de-oxidize the indigo, and the presence of ammonia is also required for the solution of indigo; we must precipitate the former so as to free the ammonia, so we see what an important part lime performs to effect this object. Lime is the balance of the vat, and the regulator of fermentation, and the nicety required in proportioning lime to the amount of carbonic acid formed, makes it the most difficult operation in the art of dyeing, for the principal difficulties of working a woad vat are in giving too much lime, or else in not giving enough."

"The quantity of lime to be given, must bear such a proportion to the quantity of carbonic acid formed, that the two substances will saturate each other, and form an insoluble

carbonate of lime, leaving the indigo and ammonia in solution, this constitutes the true working state of the woad vat." —"*Gibson's System and Science of Colors.*"

GERMAN OR SODA VAT.

This vat can be of the same dimensions as the woad vat but they are sometimes larger.

They are filled with water and heated to 200 degrees Fahrenheit, than throw in two bushels of wheat bran, 25 pounds carbonate of soda, 15 pounds indigo, 7 pounds ware, then rake it up well and let it rest two or three hours; you must watch it carefully during the progress of fermentation, regulating it by giving it either ware or soda, and if rightly managed it will be ready to color in, after 15 or 18 hours from the time it was set. The smell is the only criterion to go by,(which is a strong ammoniacal odor,) as sometimes the solution will be of a grass green color, at other times a deep olive color, and still the vat will be in good working order, so you see that it would not do to judge by the looks of the liquor in regard to its condition. This vat will do more work in a given time than any other vat that I am acquainted with, but you have to color the wool somewhat darker than your pattern as the indigo lays more loosely upon the wool, it does not penetrate into the fibre of the wool like a woad vat, and will lose more in fulling and scouring than wool colored in the woad vat. The mode of operations is the same as with a woad vat. The soda vat differs from an ash vat, by the fact that the potash is replaced by crystallized carbonate of soda and lime.

I might give a description and method of working the potash vat, copperas vat, indian vat, and pastel vat, but as these vats are but seldom used in this country, and at the present time indigo blues are not much called for, I will not swell the size of this work by giving the different methods of setting and operating them.

PRUSSIAN OR ROYAL BLUE.

This color, which is equal in beauty and splendor to scarlet and the brightest yellows, was discovered by my father (and at the time was never disputed), he being the first dyer that ever produced it upon woolen goods.

"In 1818 there were accounts published of this color being employed by the French dyers on silk, and he having seen silk goods of this color, was struck with its beauty and richness, and was anxious to discover a method of fixing it upon woolen fabrics.

"He labored and experimented with unwearied perseverance for two years before he could produce any thing fit to offer in the market, but in the summer of 1820 he succeeded (after making numberless failures) in effecting his object.

"The color being so much superior in brilliancy to all other blues, soon brought it into notice, and a high price was paid for coloring it.

"This was nine years previous to the time when Messrs. Marriot & Son and Messrs. Almon & Mellon are said by Mr. Malony to have been the only men in England who dyed it, to his knowledge, when as early as 1824 or 1825 the method of coloring it had leaked out, and there were a number of dyehouses in Yorkshire that were coloring broadcloths of that color.

"He always supposed that the above named gentlemen were the first to color it on worsted goods, but it had long been in use in a few dyehouses on broadcloths, years previous to their applying it to thin goods."

He nor others never attempted to color it upon any thing except cloth. But I claim the praise (if there is any attached to it) of being the first dyer who ever colored it upon wool that had to go through the process of fulling and scouring (and with truth it cannot be disputed), and not scour out. (The recipe for coloring this blue on wool is well worth the price of the book.)

Nitric acid will change it to a green, but this is owing to the wool changing to yellow by the effects of the acid; the blue remaining unaltered, will of course make a green. The color will improve by exposure to the rays of the sun and effects of the atmosphere, causing it to grow deeper and richer. It will stand repeated washings with any common hard soaps without having any effect upon it, and in these respects it is as permanent a color as can be dyed. But you must remember that a strong alkaline test will discharge the prussic acid (or coloring principle) and leave nothing but the oxide of iron on the wool.

Prussian Blue.

No. 1.	400	pounds	Fleece.
	40	"	Red Prussiate Potash.
	3	quarts	Sulphuric Acid.
	3	"	Nitric Acid.
	3	"	Muriatic Acid.

Dissolve the prussiate, then add the acids, do not put these materials in the bath at a higher temperature than 120 degrees Fahrenheit; at this heat you will enter the wool, (you must pole it all the time you are coloring it,) then turn on the steam, (after it has been in about ten minutes,) gradually bringing it to a boil in about an hour, which continue for fifteen minutes or until you strike the shade; leave it in the solution one hour, take out and wash off well.

Logwood Blue. (Dark.)

No. 2. 400 pounds Fleece.

Preparation.

2	pounds	Bichromate of Potash.
8	"	Potash Sulphate Alumina.
4	"	Oxalic Acid.

Boil the wool one and one-half hours.

Dyeing Process.

75 pounds Logwood.
10 " Hypernic Wood.
2 " Cudbear.

Boil one hour.

Light Blue.

No. 3. 400 pounds Third Fleece.

Preparation.

1 pound Bichromate of Potash.
6 pounds Potash Sulphate Alumina.
3 " Oxalic Acid.

Boil the wool one and one-half hours.

Dyeing Process.

25 pounds Logwood.
2 " Cudbear.

Boil one hour, or to shade.

Another Blue.

350 pounds Wool.

Preparation.

2 pounds Bichromate of Potash.
2 " Crystals of Tin.
3 " Oxalic Acid.

Boil the wool one and one-half hours.

Dyeing Process.

40 pounds Logwood.
18 " Hypernic Wood.

Boil three-fourths of an hour.

Dahlia Blue. (A splendid color.)

500 pounds Second Fleece.

Preparation.

6 pounds Chrome.
5 " Alum.
2 " Oxalic Acid.

Boil the wool one and one-half hours, then finish with

210 pounds Hypernic.
22 " Logwood.
41 " Camwood.

Boil the wool one and one-half hours.

ORDER AURORA.

The various hues of this order are more abundant than that of any other order of colors, because the yellow and red coloring principle is distributed more abundantly through nature than that of the blue.

This order of colors has very peculiar features: the yellowest of them compared with a true or pure yellow will have a red hue or shade to them, and the reddest of them will be known from any of the colors of the Order Red by having more of a yellow appearance. The aurora shades, therefore, are a medium between the reds and the yellows.

In dyeing these colors cleanliness and care are as necessary to the production of good, bright and clear colors as they are in dyeing the reds or yellows. The yellow portion of these shades is obtained from fustic, quercitron bark and flavine; the red portion from cochineal, lac dye, madder, or camwood. But the brilliancy of these colors depends very much upon the kinds of red or yellow dyestuffs employed. Fustic and camwood will make an orange good enough for listing, but the most brilliant orange is obtained from flavine and cochineal.

Wash off these colors as soon as convenient after dyeing. The yellow shades should be dried under cover, but the red-

der ones in the open air. The composition of this color is one part of yellow and one part of red.

AURORA SHADES.

Nasturtion.

No. 1. 425 pounds Texas Wool.
25 " Quercitron Bark.
5 " Super-Tartrate of Potash.
5 " Potash Sulphate Alumina.
9 " Muriate of Tin.
Boil one hour ; wash off.

Aurora.

No. 2. 400 pounds Wool.
35 " Quercitron Bark.
16 " Lac Dye.
16 " Red Tartar.
4 " Potash Sulphate Alumina.
4 quarts Muriate of Tin.
Boil one hour ; wash off.

Cane.

No. 3. 400 pounds Fourth Fleece.
10 " Quercitron Bark.
10 " Madder.
10 " Potash Sulphate Alumina.
5 " Super-Tartrate of Potash.
10 " Muriate of Tin.
Boil one hour ; wash off.

Buff.

No. 4. 375 pounds Fourth Fleece.
10 " Super-Tartrate of Potash.
1 pound Quercitron Bark.
½ " Madder.
10 pounds Muriate of Tin.
Boil one hour ; wash off well.

Dark Buff.

No. 5. 450 pounds Wool.
33 " Fustic.
3 " Red Tartar.
5 " Potash Sulphate Alumina.
1 quart Muriate of Tin.

Another Buff.

325 pounds Wool.
12 " Super-Tartrate of Potash.
8 " Murio-Sulphate of Tin.
1 pound Madder.
8 pounds Fustic.

Boil one hour; wash off.

Orange.

No. 6. 200 pounds Third Fleece.
8 " Flavine.
3 " Cochineal.
3 " Red Tartar.
5 " Alum.
4 quarts Muriate of Tin.

Boil the wool one hour; wash off well.

Another Orange. (For mixtures.)

400 pounds Fourth Fleece.
4 " Flavine.
3 " Cochineal.
1 pound Oxalic Acid.
3 quarts Muriate of Tin.

Boil the wool one-half hour. Draw off the kettle and finish in a fresh bath of

5	pounds	Cochineal.
4	"	Flavine.
1	pound	Oxalic Acid.
5	pounds	Madder.
2	quarts	Muriate of Tin.

Boil the wool three-fourths of an hour, then wash off well.

Another.

300	pounds	Fleece.
7½	"	Flavine.
7	"	Cochineal.
7	quarts	Muriate of Tin.

Boil the wool slowly for three-fourths of an hour; wash off.

ORDER VIOLET.

This color includes the lilacs, wines, lavenders, rubies, and all those colors that are composed of red and blue only. The materials used for dyeing these colors are cudbear, Hypernic wood and cochineal, for giving them the red portion; and for giving the blue portion we use logwood and indigo; but to color them in the most permanent manner, we must use indigo and cochineal with the proper mordants. The mordants for the colors made with cudbear, Hypernic and logwood, are alum, tartar and chrome. It is best to dry these colors under cover. This color is composed of equal parts of yellow and blue.

VIOLET SHADES.

Lilac.

No. 1. 400 pounds Third Fleece.

Preparation.

12 pounds Potash Sulphate Alumina.
4 " Oxalic Acid.
3 " Super-Tartrate Potash.

Boil the wool one and three-quarters hours.

Dyeing Process.

12 pounds Logwood.
12 " Hypernic Wood.

Boil the wool one hour. One or two pounds of cudbear will bloom it more if you should want it to be more bloomy.

Puce Color.

No. 2. 300 pounds Fleece.
27 " Cudbear.
6 " Super-Tartrate Potash.

Boil to shade, or from one and one-half to two hours.

Blue Violet.

No. 3. 350 pounds Third Fleece.

Preparation.

20 pounds Potash Sulphate Alumina.
5 " Red Tartar.
2 " Bicromate Potash.

Boil two hours.

Dyeing Process.

20 pounds Logwood.
7 " Hypernic Wood.
1 pound Cudbear.

Boil one hour.

Common Purple.

350 pounds Wool.

Preparation.

25 pounds Alum.
7 " Red Tartar.

Boil the wool one and one-half hours, leave it in the kettle all night, then finish off in the dyeing process with

45 pounds Hypernic Wood.
40 " Logwood.
5 " Cudbear.

Boil the wool one hour.

Fast Purple.

Color in the blue vat to a middle blue, wash off well, then use in dyeing process

18 pounds Cochineal.
7 " Super-Tartrate of Potash.
12 " Nitro-Muriate of Tin.
7 " Potash Sulphate Alumina.

Boil the wool one hour. This is a beautiful, rich and brilliant color.

Chrome Lavender.

No. 4. 300 pounds Third Fleece.

Preparation.

2 pounds Bichromate of Potash.
4 " Red Tartar.
15 " Alum.

Boil the wool one and one-half hours.

Dyeing Process.

12 pounds Hypernic.
2 " Logwood.
2 " Cudbear.

Boil the wool one hour; leave it in as long as convenient.

Lavender.

400 pounds Wool.

Color in the blue vat to a French gray, wash off, then use in the dyeing process

10 pounds Cudbear.
15 " Hypernic Wood.

Boil the wool one hour.

Another Lavender.

350 pounds Fleece.
10 " Logwood.
2 " Hypernic Wood.
2 " Camwood.
3 " Cudbear.
2½ " Red Tartar.

Boil the wool two hours, then sadden with

1 pound Proto-Sulphate of Iron.
1½ pounds Potash Sulphate Alumina.

Boil one hour.

Chrome Purple.

350 pounds Texas Wool.

Preparation.

20 pounds Potash Sulphate Alumina.
6 " Super-Tartrate of Potash.
4 " Bichromate of Potash.

Boil the wool one and one-half hours.

Dyeing Process.

100 pounds Logwood.
7 " Muriate of Tin.

Wine Color.

400 pounds Wool.

Preparation.

30 pounds Potash Sulphate Alumina.
8 " Super-Tartrate Potash.

Boil the wool one and one-half hours, leave it in the kettle all night.

Dyeing Process.

70 pounds Hypernic Wood.
25 " Logwood.
3 " Cudbear.

Boil the wool one hour.

Ruby.

300 pounds Wool.

Preparation.

4½ pounds Bichromate Potash.
4 " Super-Tartrate Potash.

Boil the wool one and one-half hours.

Dyeing Process.

30 pounds Morus Tinctoria.
20 " Hypernic Wood.
40 " Bois Rouge.
5 " Hematoxylon Campechicum.

Boil the wool one hour, let it remain in the kettle as long as convenient.

ORDER GREEN.

This color is made from equal proportions of blue and yellow; the yellow part from fustic, and the blue from either logwood or indigo, but generally from indigo.

The mordants employed are alum, tartar, chrome, and crystals of tin.

Quercitron bark and tumeric are sometimes used for giving the yellow part to greens, and for permanency are equal to fustic.

The invisible greens are nothing more than dark blues with a tinge of green to them, and generally there is a small amount of logwood used with the fustic in bodying up on an indigo bottom in order to save indigo and give fullness to the color.

The greens that are made with fustic and logwood are not of course so permanent as where indigo is used, but they are as fast as blacks, browns or olives; greens made like No. 3, will always have the olive appearance to them, which is not the case with those in whose composition indigo enters.

These colors can be dried either out doors or on the drier as suits the convenience of the dyer.

The composition of this color is, one part of blue and one part of yellow.

GREENS.

Chymic Green.

No. 1.	450	pounds	Third Fleece Wool.
	15	"	Potash Sulphate Alumina.
	4	"	Bichromate of Potash.
	2	"	Crystals of Tin.
	4	"	Sulphuric Acid.

Boil one and one-half hours. Leave the wool in all night. This will resist the milling and scouring. Finish with

30	pounds	Fustic.
50	"	Extract Indigo.
30	"	Rock Salt.

Boil all these together for one-half hour. Boil the fustic out first, before you put in the extract, etc. Boil the wool two hours, then wash off.

Chymic Green.

No. 2. 150 pounds Fleece.
30 " Fustic.
1 pound Logwood.
6 pounds Potash Sulphate Alumina.
8 " Extract Indigo.

Boil two hours.

Chrome Green.

No. 3. 400 pounds Texas Wool.
2 " Bichromate of Potash.
1 pound Super-Tartrate of Potash.
4 pounds Potash Sulphate Alumina.

Boil one and one-half hours. Finish with
20 pounds Logwood.
45 " Fustic.

Boil one and one-half hours.

Pea Green.

200 pounds Third Fleece Wool.
12 " Fustic.
12 " Alum.
5 " Extract of Indigo.

Boil one and three-fourths hours. Sadden with 4 pounds of Alum.

Woaded Green.

200 pounds Wool.

Color to a French gray in blue vat, then wash off. Finish with
45 pounds Fustic.
1 pound Sulphate Copper.
4 pounds Alum.
2½ " Red Tartar.

Boil one hour.

Another Chymic Green as good as No. 1.

400 pounds Fourth California Wool.

Preparation.

15	pounds	Potash Sulphate Alumina.
3	"	Bichromate of Potash.
4	"	Sulphuric Acid.

Boil the wool one and one-half hours, and leave it in all night; next day finish with

70	pounds	Morus Tinctoria.
25	"	Sulphate of Indigo.
5	"	Potash Sulphate Alumina.
8	quarts	Chloride Sodium (salt).

Boil out the fustic, then add the rest, and boil twenty minutes before entering the wool; boil the wool two hours. This you will find as good a color, and will stand the fulling and scouring as well as the No. 1 sample, both being perfectly fast greens.

Woaded Green.

200 pounds Wool.

Color in the blue vat to a middle blue. Wash the wool after coloring in the vat; then use for the

Preparation.

1	pound	Bichromate Potash.
4	pounds	Potash Sulphate Alumina.
2½	"	Super-Tartrate Potash.

Boil the wool one hour.

Dyeing Process.

45 pounds Fustic.

Boil the wool one hour, or until deep enough.

Invisible Green.

250 pounds Wool.

Color in the blue vat as for woaded green; then use in the dyeing process

20 pounds Fustic.
10 " Logwood.

Boil the wool one-half an hour then sadden with

2 pounds Bi-Sulphate Copper.
2 " Proto-Sulphate Iron.

Boil three-fourths of an hour.

The alum used in these greens was the "Natrona Porous," but if you have not the Natrona you will have to use one-third more of the common alums to produce the same results. (See remarks on Alum.)

ORDER BRONZE.

In dyeing this class of colors upon wool the materials generally used are logwood, camwood, fustic, madder, sumach, nut-galls and sometimes cudbear; the mordants or saddening materials are sulphate of iron, alum, tartar, and sometimes sulphate of copper. Owing to the variety both in the shades and materials used in coloring them, no exact amount of dye-stuffs can be fixed upon to produce at all times, and under all circumstances, the same particular shade of fawns or drabs.

In working upon these colors the dyer has to depend upon his judgment for the quantity and kind of articles required to produce the shade he requires.

What information that can be given in dyeing these shades is to be certain to begin coloring with little enough of the dyestuffs as more can be given if required, and if you should not get the color up to the pattern by the first amount of dyestuff you can give it more of such kinds as you ascertain to be needed by comparing your pattern with the wool you are coloring ; if it is not red enough give camwood, if not blue enough give more logwood, if it lacks yellow give it fustic, but always leave them a little lighter than the pattern, as the yellow will always come up in a fawn or drab, and the red will rise a little, that is if you use considerable camwood.

Bearing in mind that the shades given by cudbear are a bluish red; madder a yellowish red ; camwood a less yellow red in it than madder. Fustic gives the yellow, a greenish yellow from sumach, nut-galls will darken, and logwood blues up, so by remembering the cast of shade that these dyestuffs (with the saddening,) give, will enable you to use such dyestuffs as will be required to produce the shade wanted, but experience and judgment in the dyer is essential to the production of any particular shade of this order of colors, for no one can give recipes for these shades that will in all places and at all times produce the same result.

These colors are mostly dyed by either having all the dyestuffs and mordants used together or by boiling the wool in the dyestuffs first and afterwards saddening down.

The recipes and samples will give you a sufficient idea how you must vary the dyestuffs to produce the pattern you have to color for.

It will be best to dry these colors under cover, that is on the drier.

The composition of this color is one part of yellow, one part of red and one of blue.

MINOR SHADES OF BROWN.

FAWNS.

Salmon Fawn.

No. 1. 425 pounds Wool.
6 " Red Tartar.
10 " Muriate of Tin.
4 " Fustic.
2 " Lac Dye.

Boil one hour, and wash off well.

Fawn.

No. 2. 375 pounds Wool.
4 " Super-Tartrate of Potash.
5 " Fustic.
10 " Camwood.

Boil one and one-half hours.

Sandy Fawn.

No. 3. 300 pounds Wool.
3 " Fustic.
6 " Camwood.
6 " Red Tartar.
1 pound Potash Sulphate Alumina.

Boil one and one-half hours.

Esterhazy Fawn.

No. 4. 400 pounds Wool.
4 " Cudbear.
5 " Camwood.
5 " Fustic.

Boil one and one-half hours, then sadden with
1 pound Proto-Sulphate Iron.

Boil one-half hour.

Flesh Fawn.

No. 5. 400 pounds Wool.
7 " Nut-Galls.
5 " Sumach.
3 " Camwood.

Boil one and one-half hours.

Another Fawn.

250 pounds Wool.
3 " Madder.
3 " Camwood.
4½ " Fustic.

Boil one and one-half hours, then sadden with
½ pound Proto-Sulphate of Iron.

Boil one-half hour.

Drab Fawn.

No. 6. 400 pounds Third Fleece.
1 pound Fustic.
3 pounds Sumach.
5 " Nut-Galls.
1¼ " Camwood.

Boil one hour, then enter the wool and boil one and one-half hours; then sadden with

6 ounces Sulphate of Iron.
6 " Alum.

Another Salmon Fawn

Redder than No. 1.

360 pounds Wool.
3 " Fustic.
6 " Camwood.
6 " Super-Tartrate Potash.
1 pound Potash Sulphate Alumina.

Boil one and one-half hours.

Bronze.

500 pounds Third Fleece.

Preparation.

7 pounds Bichromate of Potash.
4 " Super-Tartrate of Potash.

Boil the wool one and one-half hours.

Dyeing Process.

8 pailsfull Fustic (or 64 pounds).
10 " Madder (or 90 pounds).
1 pound Logwood.

Boil the wool one hour.

MINOR SHADES OF PLUM.

Dark Slate.

No. 1. 400 pounds Wool.
25 " Logwood, (chips).
2 " Potash Sulphate Alumina.

Boil one-half an hour, then sadden with

4 pounds Sulphate Iron.

Boil one-half an hour.

Another Method for the same Shade.

400 pounds Wool.
20 " Logwood, (chips.)
2 " Potash Sulphate Alumina.
3½ " Sulphate Iron.

Boil out the logwood for one and one-half hours, then add the alum and iron, enter the wool and boil one hour.

Lead.

No. 2. 400 pounds Wool.
12 " Logwood, (chips.)
1 pound Sumach.
½ " Red Tartar.
¼ " Cudbear.

Boil one and one-half hours, then sadden with

¼ pound Potash Sulphate Alumina.
1½ pounds Sulphate Iron.

Boil one-half hour.

Slate.

No. 3. 425 pounds Wool.
15 " Logwood, (chips.)
½ pound Sumach.
½ " Red Tartar.

Boil one hour then sadden with

1 pound Sulphate Iron.

Boil one-half hour.

A Shade between No. 2 and No. 3.

450 pounds Wool. (California.)
1½ " Hematine.
¼ pound Sumach.
½ " Red Tartar.
¼ " Cudbear.

Boil one hour, sadden with

1 pound Sulphate Iron.

Boil one-half hour.

Another Slate.

400 pounds Wool.
2 " Hematine, or 10 pounds Logwood chips.
½ pound Sumach.
½ " Cudbear.
½ " Red Tartar.

Boil one and one-half hours, then sadden with

1½ pounds Sulphate Iron.

Boil one-half hour.

Another.

A splendid dark shade.

500 pounds Third Fleece.
9 " Logwood (chips).
8 " Camwood.
1½ " Glauber Salt.
2 " Red Tartar.
½ pound Oil Vitriol.

Boil one and one-half hours, then sadden with

½ pound Potash Sulphate Alumina.
½ " Sulphate Iron.

Boil one-half hour.

The recipes given for the minor shades of brown, plum and olive will give the dyer a sufficient idea how to vary the dyestuffs in coloring to different patterns. The dyer in making these colors has to depend more upon his judgment, as regards the quantity and kind of dyestuffs necessary to produce a certain effect, than in any other color.

All these minor shades or colors should be dried under cover. The weight of wool named with each recipe is for wool in the grease.

MINOR SHADES OF OLIVE.

DRABS.

Brown Drab.

No. 1.	450	pounds	Texas Wool.
	30	"	Fustic.
	15	"	Camwood.
	4	"	Logwood.
	6	"	Sumach.

Boil one and one-half hours, then sadden with

4 pounds Sulphate Iron.
1 pound Potash Sulphate Alumina.

Boil one-half hour.

Stone Drab.

No. 2.	450	pounds	Texas Wool.
	20	"	Fustic.
	5	"	Madder.
	8	"	Camwood.
	½	pound	Nut-Galls.
	1	"	Logwood.

Boil one and one-half hours, sadden with

3 pounds Sulphate Iron.
½ pound Potash Sulphate Alumina.

Boil three-fourths of an hour.

Sage Drab.

No. 3.	450	pounds	Texas Wool.
	35	"	Fustic.
	15	"	Camwood.
	4	"	Logwood.
	6	"	Sumach.

Boil one and one-half hours, sadden with

4 pounds Sulphate Iron.
1 pound Potash Sulphate Alumina.

Boil one-half hour.

Tan Drab.

No. 4. 375 pounds Fleece.
80 " Fustic.
30 " Camwood.
20 " Madder.

Boil one and one-half hours, sadden with
5 pounds Sulphate Iron.
2 " Potash Sulphate Alumina.

Boil three-fourths of an hour.

Drab.

No. 5. 400 pounds Third Fleece.
1 pound Fustic.
3 pounds Sumach.
5 " Nut-Galls.
1½ " Camwood.

Boil one and one-half hours, sadden with
6 ounces Sulphate Iron.
6 " Potash Sulphate Alumina.

Boil one hour.

Dark Fawn Drab.

No. 6. 360 pounds Fleece.
6 " Fustic.
11 " Camwood.
15 " Madder.
2 " Red Tartar.

Boil one and one-half hours, sadden with
5 ounces Sulphate Iron.
5 " Potash Sulphate Alumina.

Boil one-half hour.

A Beautiful Light Drab.

450 pounds Fine Fleece.

Preparation.

15 pounds Alum.
3½ " Bichromate Potash.
1 pound Crystals of Tin.
4½ pounds Sulphuric Acid.

Boil one and one-half hours, let the wool remain in over night. Finish with

3 pounds Logwood.
2 ounces Hoffman's Aniline, B. B. B.

Boil one hour.

Olive Drab.

350 pounds Wool.
3 " Logwood.
12 " Fustic.
6 " Madder.

Boil one and one-half hours, sadden with

1½ pounds Sulphate Iron.
¾ pound Sulphate Copper.

Boil three-fourths of an hour.

Very Light or Silver Drab.

500 pounds Wool.
2½ " Camwood.
2 " Cudbear.

Boil one and one-half hours, sadden with

2 ounces Sulphate Iron.

Drab.

No. 7. 250 pounds Third Fleece.
1 pound Sumach.
2½ pounds Logwood.
½ pound Cudbear.
½ " Fustic.
½ " Red Tartar.
½ " Nut-Galls.
½ " Sulphate Iron.

Enter the wool and boil one hour.

Slate Drab.

No. 8. 400 pounds Fourth Fleece.
7 " Logwood.
3 " Fustic.
2½ " Cudbear.
4 " Red Tartar.
2 " Alum.
1 pound Sulphate Iron.

Boil the logwood and fustic one and one-half hours, then dissolve the tartar, alum, and iron, then enter the wool and boil one hour. Proceed in the same manner with No. 7. Always boil out the dyestuffs before putting in earthy or metallic salts, in all cases where all the materials are given in one bath.

Fast Sage.

300 pounds Fleece.

Color in the blue vat to a light blue or French gray, then wash off the wool and finish with

15 pounds Fustic.

Boil the wool one hour, then sadden with

1 pound Sulphate Iron.
1 " Sulphate Copper.

Boil three-fourths of an hour.

ORDER BROWN.

In coloring browns the dyestuffs used principally are madder, fustic, camwood, logwood, hypernic wood, and sometimes barwood and red sanders, and most of these woods being hard and resinous they require longer boiling to bring out their coloring matter than does logwood; and wool must be boiled longer in their solutions in order to have the wool combine with the coloring matter before we attempt to sadden down, as the camwood, madder, and barwood will not give out any more color after the metallic salts are thrown into the kettle, but fustic will continue to give body through the whole time of coloring.

In coloring to a pattern you should bear in mind that the red and yellow will always rise during the after process of manufacturing and that the darker loses. They should therefore be left a little shorter of red and yellow than your pattern, especially those browns that are saddened with copperas.

The composition of brown is two parts of yellow, two parts of red and 1 part of blue.

BROWNS.

Red Brown.

No. 1. 400 pounds Third Fleece.

Preparation.

4½ pounds Bichromate Potash.
4½ " Super-Tartrate Potash.

Boil one and one-half hours.

Dyeing Process.

8 pails of Fustic.
8 " Camwood.

Boil the wool one hour.

Light Olive Brown.

No. 2. 400 pounds Fleece.

Preparation.

4	pounds	Bichromate Potash.
$2\frac{1}{2}$	"	Super-Tartrate Potash.
2	"	Potash Sulphate Alumina.

Boil one and one-half hours.

Dyeing Process.

9	pails of	Fustic.
18	pounds	Camwood.
15	"	Madder.

Boil the wool one and one-half hours.

Cinnamon Brown.

No. 3. 400 pounds California.

Preparation.

3	pounds	Bichromate of Potash.
3	"	Super-Tartrate Potash.
3	"	Potash Sulphate Alumina.

Boil the wool one and one-half hours.

Dyeing Process.

50	pounds	Camwood.
60	"	Fustic.
7	"	Madder.

Boil the wool one hour.

Brown.

No. 4. 500 pounds Third Fleece.

Preparation.

7 pounds Bichromate Potash.
1 quart Sulphuric Acid.

Boil the wool one hour.

Dyeing Process.

90 pounds Fustic.
110 " Camwood.
25 " Madder.

Boil the wool one and one-half hours.

Dark Olive Brown.

500 pounds Fribs.

Preparation.

7 pounds Bichromate of Potash.
7 " Super-Tartrate of Potash.

Boil one and one-half hours.

Dyeing Process.

8 pailsfull Fustic.
3 " Camwood.
1 pailfull Logwood.
7 pounds Madder.

Boil one hour, then sadden with

4 pounds Sulphate of Iron.

Boil one-half hour.

Bismarck Brown.

400 pounds Fleece.

Preparation.

6 pounds Bichromate of Potash.
6 " Potash Sulphate Alumina.

Boil one and one-half hours.

Dyeing Process.

120 pounds Fustic.
50 " Madder.
30 " Barwood.

Boil one and one-half hours, then sadden with

5 pounds Blue Vitriol.
7 " Sulphate of Iron.

Boil one-half hour.

Golden Brown.

400 pounds Fleece.

Preparation.

6 pounds Bichromate of Potash.
6 " Potash Sulphate Alumina.

Boil one and one-half hours.

Dyeing Process.

120 pounds Fustic.
20 " Madder.
20 " Camwood.

Boil two hours.

Coffee Brown.

350 pounds Fleece.

Dyeing Process.

50 pounds Fustic.
60 " Camwood.
30 " Madder.

Boil the wool two hours.

Saddening or Mordant Process.

5 pounds Proto-Sulphate of Iron.
3 " Bi-Sulphate of Copper.

Boil one hour.

Olive Brown.

400 pounds Fleece.
75 " Fustic.
40 " Camwood.
25 " Madder.
10 " Logwood.

Boil the wool two hours, then sadden with
4 pounds Sulphate Iron.

Boil one hour.

Chrome Brown.

400 pounds Fleece.

Preparation.

5 pounds Bichromate of Potash.
2½ " Bi-Sulphate of Copper.

Boil one and one-half hours.

Dyeing Process.

65 pounds Fustic.
35 " Hypernic Wood.
3 " Logwood.

Boil the wool one hour.

Cinnamon Brown.

450 pounds Third Fleece.
90 " Fustic.
20 " Madder.
30 " Camwood.

Boil the wool two hours, then sadden with
10 pounds Blue Vitriol.

Boil the wool one hour.

ORDER PLUM.

These shades include the claret, mulberry, adelaide, and others that have a purple hue to them and cannot be called browns, because they have not enough orange in their composition. Neither are they olives, because they lack the green, the composition of plum being bronze and violet: that is, having two parts of blue, two parts of red, and one part of yellow in its composition.

It is said that browns always work harsh, especially in carding, and if there is any reality in the report, it is in a measure applicable to these colors ; and if such is the case, it is unavoidable, and must be put up with until there is some coloring material discovered that will produce these deep colors without leaving such bad effects. To avoid as much as possible these effects, we should, in saddening down, be cautious in giving the mordant, and give no more than is absolutely required to produce the result we wish for, and not boil any longer than needed after saddening.

Let these colors be dried out of doors. If you are coloring to a pattern, leave the wool on the blue or darker side of the pattern, as the red will rise considerable.

Claret.

No. 1. 400 pounds California Wool.

Preparation.

3 pounds Bichromate Potash.
3 " Potash Sulphate Alumina.
3 " Super-Tartrate Potash.

Boil one and one-half hours.

Dyeing Process.

50 pounds Hypernic.
45 " Camwood.

Boil one and one-half hours, then sadden with

5 pounds Bi-Sulphate Copper.

Boil one-half hour.

Wine Claret.

400 pounds Second Fleece.

Preparation.

6 pounds Chrome.
1 pound Oxalic Acid.

Boil one and one-half hours.

Dyeing Process.

120 pounds Camwood.
30 " Fustic.
40 " Hypernic.

Boil one and one-half hours.

Dark Claret.

500 pounds Fleece.
90 " Fustic.
150 " Camwood.
20 " Hypernic.
4 " Red Tartar.
½ pound Sulphuric Acid.

Boil one and one-half hours, then sadden with

4 pounds Proto-Sulphate Iron.

Boil one hour.

Maroon.

No. 2. 400 pounds Texas Wool.

Preparation.

20 pounds Alum.
4 " Red Tartar.
2 " Bichromate Potash.

Boil one and one-half hours.

Dyeing Process.

40 pounds Hypernic.
7 " Logwood.

Boil one and one-half hours.

Plum.

No. 3. 300 pounds Fleece Wool.

Preparation.

2 pounds Chrome.
2 " Red Tartar.
5 " Alum.

Boil one and one-half hours.

Dyeing Process.

27 pounds Cudbear.
8 " Logwood.

Boil one and one-half hours.

Another Plum.

350 pounds Fleece Wool.

Dyeing Process.

50 pounds Camwood.
60 " Logwood.

Boil two hours then sadden with

6 pounds Sulphate Iron.
6 " Bi-Sulphate Copper.

Boil one hour.

A Rich Reddish Plum.

400 pounds Fleece.

Preparation.

4 pounds Chrome.
3 " Alum.
2 " Red Tartar.

Boil one and one-half hours, leave the wool in this solution all night.

Dyeing Process.

30 pounds Cudbear.
20 " Hypernic.
4 " Logwood.

Boil these dyestuffs one-half an hour, cool down the solution, enter the wool and boil one-half an hour, and draw off.

Tyrian Purple.

250 pounds Second Wool.

Preparation.

32 pounds Potash Sulphate Alumina.
8 " Super-Tartrate Potash.
4 " Bi-Sulphate Copper.

Boil one and one-half hours.

Dyeing Process.

180 pounds Logwood.
1 pound Lime.

Boil one and one-half hours.

Adelaide.

250 pounds Third Wool.

Color in the blue vat to a two-thirds blue then wash off the wool.

Dyeing Process.

22 pounds Camwood.
8 " Hypernic Wood.
4 " Logwood.

Boil the wool one hour, then sadden with

4 pounds Potash Sulphate Alumina.
2 " Super-Tartrate Potash.

Boil three-fourths of an hour.

This is a full, rich, and beautiful color.

Mulberry.

No. 4. 400 pounds Third Wool.

Preparation.

4 pounds Potash Sulphate Alumina.
3 " Bichromate Potash.
2 " Oxalic Acid.

Boil one and one-half hours.

Dyeing Process.

70 pounds Hypernic.
10 " Logwood.
18 " Camwood.
3 " Cudbear.

Boil one and one-half hours, sadden with

5 " Blue Vitriol.

Boil one-half an hour.

ORDER OLIVE.

This is a handsome color if dyed properly, if not, there is no color that looks any meaner, as it will be a thin and lusterless color if not well dyed. In coloring these colors do not be sparing of the dyestuffs, and for those that you make by stuffing and saddening, be sure and boil the wool until it is thoroughly impregnated with the coloring solution before you begin to sadden down. If you are coloring to a pattern, leave the wool looking greener than your pattern, as the yellow and red rise in the process of manufacturing. The red will rise the most, especially if you use either camwood or barwood. The composition of this color is one part red, two parts yellow, and two parts blue.

There are various shades of olives, but the three samples I thought would be sufficient for the dyer, along with the other recipes. I regret that I have no samples to go with the recipes for the fast or true olives.

OLIVES.

Olive.

No. 1. 400 pounds Fourth Fleece.

Preparation.

4 pounds Bichromate Potash.
4 " Super-Tartrate Potash..
2 " Potash Sulphate Alumina.

Boil one and one-half hours.

Dyeing Process.

90 pounds Fustic.
12 " Madder.
20 " Camwood.
8 " Logwood.

Boil one and one-half hours, then sadden with

1 pound Copperas.
1 " Blue Vitriol.

Boil one-half hour.

Chrome Olive.

No. 2. 425 pounds Texas.

Preparation.

5 pounds Bichromate Potash.
3 " Super-Tartrate Potash.
3 " Potash Sulphate Alumina.

Boil one and one-half hours.

Dyeing Process.

45 pounds Fustic.
25 " Logwood.
10 " Madder.

Boil one hour, or to shade.

Yellow Olive.

No. 3. 400 pounds Fleece.

Preparation.

4 pounds Bichromate Potash.
4 " Super-Tartrate Potash.
2 " Potash Sulphate Alumina.

Boil one and one-half hours.

Dyeing Process.

85 pounds Fustic.
20 " Madder.
20 " Camwood.

Boil one and one-half hours.

Green Olive.

500 pounds Fleece.

Preparation.

3 pounds Bichromate Potash.
5 " Potash Sulphate Alumina.

Boil one and one-half hours.

Dyeing Process.

75 pounds Fustic.
8 " Logwood.
6 " Madder.
3 " Sumach.

Boil one and one-half hours.

Another Green Olive.

400 pounds Third Fleece.
70 " Fustic.
45 " Logwood.

Boil two hours, then sadden with

7 pounds Copperas.

Dark Green Olive.

500 pounds Third Fleece.

Preparation.

8 pounds Bichromate Potash.
8 " Super-Tartrate Potash.

Boil one and one-half hours.

Dyeing Process.

13 pails full Fustic.
1 pail full Camwood.
15 pounds Madder.
20 " Logwood.

Boil one and one-half hours.

Yellow Olive.

Lighter than No. 3 and more yellow.

400 pounds Fourth Fleece.

Preparation.

3 pounds Bichromate Potash.
3 " Super-Tartrate Potash.

Boil one and one-half hours.

Dyeing Process.

50 pounds Fustic.
3 " Madder.
10 " Sumach.
7 " Cutch.
1 pound Logwood.

Boil one and one-half hours. A deep, heavy color.

Bismarck Olive.

400 pounds Second Fleece.

Preparation.

6 pounds Bichromate Potash.
6 " Super-Tartrate Potash.
6 " Potash Sulphate Alumina.

Boil one and one-half hours.

Dyeing Process.

190 pounds Fustic.
10 " Madder.
12 " Camwood.
5 " Logwood.

Boil one and one-half hours, then sadden with

3 pounds Bi-Sulphate Copper.
3 " Sulphate Iron.

Olive.

400 pounds Fleece.

Preparation.

2 pounds Bichromate Potash.
4 " Super-Tartrate Potash.

Boil one and one-half hours.

Dyeing Process.

30 pounds Fustic.
3 " Madder.
12 " Logwood.

Boil one and one-half hours.

True Olive.

400 pounds Fleece.

Color in the blue vat to a middle blue, wash off the wool, then finish with

100 pounds Fustic.
25 " Madder.

Boil the wool one and one-half hours, then sadden with

8 pounds Blue Vitriol,

and boil one hour.

Another True or Fast Olive.

400 pounds Fleece.

Color in the vat to a pale blue, then use in the

Dyeing Process

95 pounds Fustic.
18 " Madder.

Boil one and one-half hours, then sadden with

5 pounds Proto-Sulphate Iron.
2 " Bi-Sulphate Copper.

Boil one hour.

ORDER BLACK.

I need make but few remarks upon this color, it being a color that every one that has worked in a dyehouse any length of time can color it, but there are various methods for producing a black, and every dyer has his own peculiar method, yet in order to have this work complete we must give some recipes for blacks, and I have not given any samples with these recipes as they are not needed.

There being but two kinds of black, (jet black and blue black.) I will give my methods of dyeing them.

Black is a color that should not be dried too much but left rather damp for the cards, as it will work better when it is damp than when thoroughly dry.

This color is composed of three parts red, three parts blue, and three parts yellow, or all of the primary colors are absorbed in black.

Jet Black.

400 pounds Wool.
100 " Logwood.
10 " Fustic.

Boil the wool one and three-fourths hours, then sadden with

13 pounds Sulphate Iron.

Boil one hour. Wash off the wool or not, as suits your convenience.

Blue Black.

400 pounds Wool.
70 " Logwood.
8 " Camwood.

Boil the wool one hour, then sadden with

2½ pounds Alum.
2½ " Blue Vitriol.

Boil half an hour, then throw on 7 pounds Copperas, and boil one hour longer.

Madder Black.

400 pounds Wool.
50 " Madder.
50 " Logwood.
20 " Sumach.

Boil the wool two hours, then sadden with

15 pounds Proto-Sulphate Iron.

Boil one hour.

This is the best and fastest black colored by stuffing and saddening.

Chrome Black, (Jet.)

400 pounds Wool.

Preparation.

3 pounds Bichromate Potash.
5 " Bi-Sulphate Copper.
1 quart Sulphuric Acid.

Boil the wool one and one-half hours.

Dyeing Process.

100 pounds Logwood.
10 " Fustic.

Boil the wool one hour.

Blue Black.

400 pounds Wool.

Preparation.

6 pounds Bichromate Potash.
3 pints Sulphuric Acid.

Dyeing Process.

100 pounds Logwood.
Proceed as for jet black.

INDIGO BLACKS.

Blue Black.

400 pounds Wool.

Color in the blue vat to medium blue, wash the wool well, then finish off with

50 pounds Logwood.
6 " Fustic.

Boil the wool in this one and one-half hours, then sadden with

7 pounds Copperas.
3 " Blue Vitriol.

Boil one hour.

Jet Black.

400 pounds Wool.

Color in the vat to a three-quarters full blue, wash off well, then finish with

70	pounds	Logwood.
20	"	Sumach.
10	"	Fustic.

Boil the wool two hours, then sadden with

8	pounds	Proto-Sulphate Iron.
4	"	Bi-Sulphate Copper.

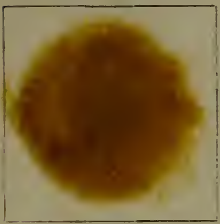
Boil one hour.

These blacks are too expensive for most manufacturers, therefore I suppose it was no need of inserting them in this work, but it is well enough to know how to produce a fast or proof black, or a black that will never fade.

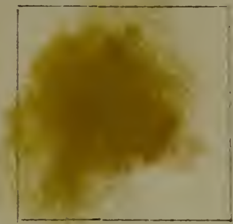
The American Dyer Samples.

YELLOWS.

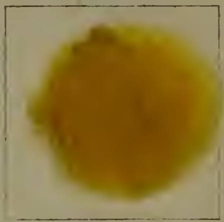
No. 1.
FUSTIC YELLOW.



No. 2.
BARK YELLOW.

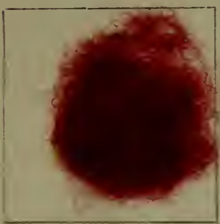


No. 3.
CANARY YELLOW.

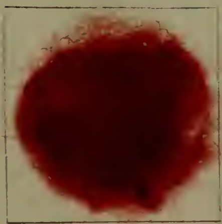


REDS.

No. 1.
CRIMSON.



No. 2.
SCARLET.

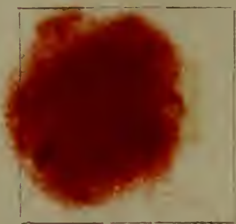


No. 3.
SCARLET.

REDS.

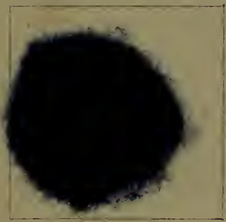
No. 4.
GERANIUM.

No. 5.
BURNS' ORANGE.



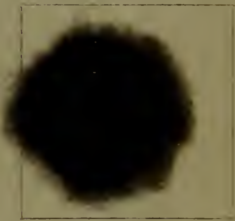
BLUES.

No. 1.
PRUSSIAN.



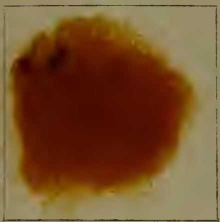
No. 2.
DARK BLUE.

No. 3.
LIGHT BLUE.

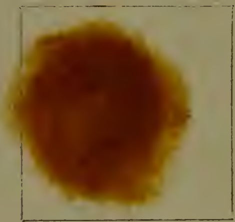


AURORA SHADES.

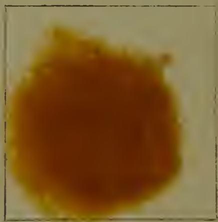
No. 1.
NASTURTION.



No. 2.
AURORA.



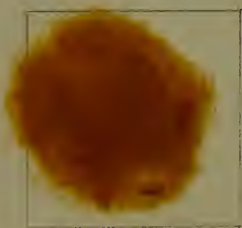
No. 3.
CANE.



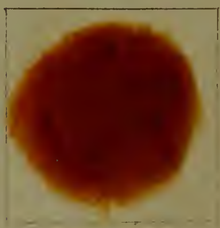
AURORA SHADES.

No. 4.
BUFF.

No. 5.
DARK BUFF.



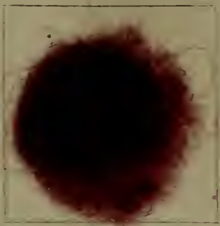
No. 6.
ORANGE.



ORDER—VIOLET.

No. 1.
LILAC.

No. 2.
PUCE.

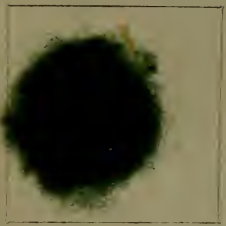


No. 3.
BLUE VIOLET.

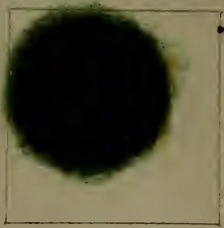
No. 4.
CHROME LAVENDER.

GREENS.

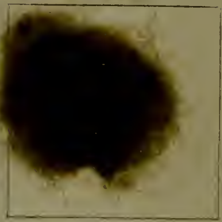
No. 1.
CHYMIC GREEN.



No. 2.
CHYMIC GREEN.

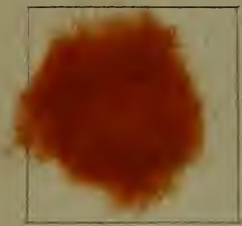


No. 3.
CHROME GREEN.



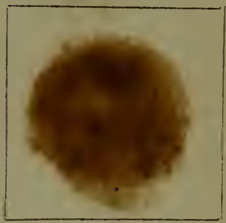
BRONZE,
Or Minor Shades of Brown.

No. 1.
SALMON FAWN.



No. 2.
FAWN.

No. 3.
SANDY FAWN.



BRONZE,
Or Minor Shades of Brown.

No. 4.
ESTERHAZY FAWN.

No. 5.
FLESH FAWN.

No. 6.
DRAB FAWN.

Minor Shades of Plum.

No. 1.
DARK SLATE.

No. 2.
LEAD.

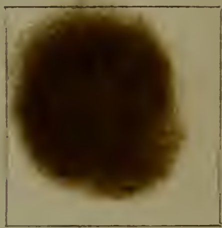
No. 3.
SLATE.

Minor Shades of Olive.

No. 1.
BROWN DRAB.

No. 2.
STONE DRAB.

No. 3.
SAGE DRAB.



Minor Shades of Olive.

No. 4.
TAN DRAB.

No. 5.
DRAB.

No. 6.
DARK FAWN DRAB.

Minor Shades of Olive.

No. 7.

Drab.

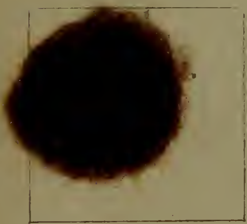
No. 8.

Slate Drab.

BROWNS.

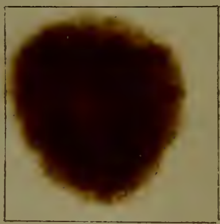
No. 1.

Red Brown.



No. 2.

Light Olive Brown.



BROWNS.

No. 3.

Cinnamon Brown.

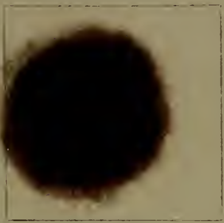
No. 4.

Brown.

PLUMS.

No. 1.
CLARET.

No. 2.
MAROON.



No. 3.
PLUM.

PLUMS.

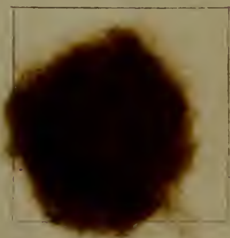
No. 4.
MULBERRY.

OLIVES.

No. 1.
OLIVE.

No. 2.
CHROME OLIVE.

No. 3.
YELLOW OLIVE.



PART THIRD.

THE ART OF DYEING

Raw Cotton or Cotton Waste,

TO WORK WITH COLORED WOOL IN THE MANUFACTURE OF

Mixtures or Plain Cloth, Double and Twist Goods, Tweeds, Satinets,

AND ALL OTHER GOODS IN WHICH COTTON IS NOW WORKED ALONG WITH WOOL.

PART THIRD.

REMARKS ON COTTON DYEING.

In dyeing raw cotton or cotton waste it seems as though we were performing an operation entirely contrary to its nature, as it seems to oppose to this unnatural process an obstinate resistance to receive or imbibe color, or such mordants as are intended for combination with it; and when it has been forced to absorb a quantity of coloring liquor, it will retain it with such tenacity that no common draining will clear it from the liquor of a first process, so as to enable it to receive the full benefit of a second dye; and it has such a feeble affinity for coloring matter, which in most cases it seems only to combine with by the intervention of a third substance that will act as a medium between the two.

These are the principal difficulties the dyer has to contend with in coloring raw cotton, and may be summed up as follows:

1st. Its feeble attraction or weak affinity for colors.

2d. Its strong retention of a liquid when once saturated with it.

3d. Its weak power of retaining colors if exposed to external agents.

We must, therefore, examine these difficulties very minutely, in order to arrive at the best plans and the best materials for producing the best results.

The first thing to be taken into consideration in coloring cotton, either in the raw material, in yarn, or in the manufactured fabric, is the difficulty with which it imbibes color.

Experience has taught us that it will combine with some coloring matters easier and more permanently than with others, and those coloring matters are such as contain the most tannin or astringency in their watery solutions. Cotton has a stronger affinity for tannin or astringent principle than for any other substance used to produce color, therefore the propriety of the cotton being impregnated with the astringent or tannin principle before the coloring matter is applied, more especially for dark shades, and for every shade that will bear such a foundation. The impregnation of the cotton with the astringent principle cannot be considered a dyeing operation, but as a preparatory step to succeeding processes of dyeing, because the astringent principle is not a color, but the medium through which a union is more readily effected between the coloring matter and the article to be colored.

There are many vegetable substances that contain the tannin or astringent principle, among which are catechu, cutch, nut-galls, sumach and divi-divi. (The last is chiefly used for cotton yarn dyeing.)

The most permanent colors on cotton waste are those that require the above materials in their composition, and there is but a very few colors made upon cotton waste in which we cannot use the above substances in producing them.

Every dyer knows why the same colors put upon cotton will not resist the action of those agencies that remove them as well as the same color will when placed upon wool. He knows that the result of the dyeing is different on the two substances: on cotton it is nothing but a mechanical fixation of color upon the cotton, but on wool it is a chemical combination of it with the fibre or body of the wool.

The most essential object in coloring cotton is to have the colors permanent, and we cannot accomplish this, in the strictest sense of the word, unless we first bring the cotton into a state of retaining color (a quality it does not really possess), and this can only be done by impregnating it with an astringent substance, such as catechu or sumach, then in

a fresh bath subjecting it to the mordant process, in a solution of some of the metallic or earthy salts, such as bichromate of potash, bi-sulphate of copper, etc.; and then to the dyeing process, in another liquor composed of such dyestuff or coloring matter as that color will require.

In the recipes you will find that all of them are not done by the above processes, but such as are done in that manner you can rely upon as being *fast*, and the others very near as permanent.

GENERAL RULES TO BE OBSERVED IN COLORING RAW COTTON OR COTTON WASTE.

1st. Have different coloring liquors, clear solutions of the coloring matter and free from sediment or loose dyestuff. to insure this use the extracts.

2d. To always have the cotton well shook up and opened before entering into the different baths, and especially as it comes from one bath to go into another; let this be the case always and for all colors.

3d. To throw in the cotton as quick as possible, boiling your solution at the same time, as it will help to get every portion imbued with the liquor.

4th. To let the cotton remain in the solutions as long as possible; it is more important to let it remain in the liquors, than it is to boil it in them, give it all the time in the liquors that you can, as it will take up the coloring matter slowly under any circumstances, but better under a boil than with it.

5th. Between every dip give plenty of time to drain, and air well, or you can extract the cotton if you have an extractor.

6th. To carry none of the preceding liquor (in the cotton) from one bath to that of another, this you can obviate by using the extractor as above mentioned.

7th. Not to boil the cotton too long or too hard; it is only because it will not wet through without it that any great amount of boiling is required.

8th. Not to crowd too much cotton into the tub or kettle, it is a very poor practice to crowd wool in the kettle, and much more so to crowd cotton. The proper quantity for a kettle is when you have a vessel that will carry four hundred pounds of wool (in the grease) two hundred pounds of cotton is sufficient for dark colors, but for light colors two hundred and fifty pounds, any variation from these rules will accompany each recipe.

FULLING AND SCOURING.

Fulling and scouring cotton and wool mixed fabrics has had but little attention paid to it in comparison to its importance. It is of little use for a dyer to exert his skill and exhaust his care and patience to produce the best and most permanent colors, if they are afterwards to be deteriorated by the ignorance or carelessness of those that may have the charge of the fulling and scouring. Colors are not unchangeable, but, on the contrary, most, and we might say all, of them are very susceptible of change or alteration by the action of different operations and substances, and we are not always to look at what the color is when it comes from the hands of the dyer, but at what it will be when finished and ready for the market.

There is no part of the manufacturing of the fabric that injures the colors so much as that of the above operation, upon which it is necessary for us to comment; for the most injury to colors upon cotton, when mixed with wool, can be traced

to the fulling and scouring. I do not mean to say that the gigging will not impair the colors — hard gigging will very often strip the colors from both cotton and wool; but we know that the friction and heat created by the operation of fulling will impair cotton colors, independent of any thing else, and from the effects of this the fuller should be exonerated from all blame.

But it is the injudicious use of alkalies and strong alkaline soaps that are used for fulling and scouring that have the most destructive effects upon colors, and for this the person who has charge of the finishing is in the greatest measure responsible. Soap that contains an excess of alkali will not only change the hue, but by the heat and caustic nature of those articles will dissolve a portion of any color we may place upon cotton, and in most cases will entirely destroy them.

These destructive effects can be avoided, and it is the duty of the overseer of the finishing, as well as of the superintendent, to see that they are avoided. I have known such an excess of soda-ash being used in the scouring soap that not only were fancy colors destroyed, but chrome blacks were changed to a plum color. The great fault of fullers is making strong alkaline solutions for scouring out the goods after they have been fulled, but there is nothing more erroneous, and no intelligent fuller would do it. The alkali used in scouring should be of just strength enough to combine with the soap that is used to full the cloth and start the oil used for the previous operations of manufacturing, and any thing more than that is a waste of alkali and an injury to the fabric and color.

An alkali of uniform strength should at all times be maintained, and is at all times required; also, one kind of soap should be purchased, and then the fulling and scouring will be done with ease, certainty and economy, and the preservation of the colors will always be insured.

There are two things that are essentially necessary in the making of fulling soaps:

1st. A perfect freedom from all uncombined alkali.

2d. A uniformity of composition in the given quantities ot its constituent parts, in each and every separate making.

There is not only a difference in soaps made by different manufacturers, but in soaps made at different times by the same manufacturer, which is the cause of some of the difficulties the fuller has to contend with. The cause of these differences in soap originate from the fact that there are but few soap makers that know what kind of soap is wanted for fulling and scouring purposes, or how to combine the alkali with the fatty matters they employ, in a just and chemical proportion. Neither are they aware that uniformity of the soap is requisite in order to produce the same effects at different times.

There is but one soap manufactory that I know who steadily and systematically adhere to the above mentioned requisites in making soap for fulling and scouring cotton and wool mixed fabrics, and that is the "Holbrook Manufacturing Company, of New York," (62 Church street,) they being qualified both by information and large experience to make an article of soap that will answer all the requirements of this branch of manufacturing; their soaps are *always uniform*, and the alkalies employed are so blended, neutralized, and combine with the oily or fatty substances used in making their different kinds of soap that it is almost an impossibility for them to injure the most delicate colors.

I have seen the soap made by the Holbrook Manufacturing Company used for several years both in the western and eastern States, and have always found it to be good and uniform in quality and exceedingly well adapted for all the work in every particular that I have named. It is especially adapted for fulling and scouring fabrics that have aniline colors in them and if cloth that has the Nicholson blue in it is fulled and scoured with the above soap, the color will come

out all right without the necessity of its being run through acidulated water to develop the color after it is scoured, which is not the case in using any other kind of soap, thereby saving a great deal of trouble for the finisher.

RECIPES.

Each of the recipes are given for the weight of cotton mentioned, and the samples are numbered to correspond with the number attached to the recipe that they were colored with; there will be found a number of recipes without samples as I did not retain any samples of the colors produced by them, but any intelligent dyer can vary the shades by different combinations of the recipes given so as to obtain the particular shade he wants. Having colored with these recipes for sometime, and given the preference to them above all others, on account of their ceitainty and effectiveness, they can be fully relied upon for the accuracy of their results. You will find observations attached to such of them as will require any deviation from the usual way or mode of dyeing, and there will be recipes given to produce the same color by different materials and methods. In making up the liquors according to the recipes, care must at all times be taken to have all the solutions when ready for the cotton, free from all ground or chipped dyestuffs, and all undissolved coloring matters, the liquors must be clear and all the materials of the bath held in solution. If you have to use sumach or any ground dyestuffs boil them out in some convenient vessel, (a barrel for instance,) and add the clear solution to the dyeing bath, but it is more convenient to use the extracts of the dyestuff, and the extracts are better than the rough dyewoods as they contain more of the tannin or

astringent principle which has a great affinity for cotton; in using the extracts you can keep the dyeing liquors at one strength and for a long time by fishing out the cotton from the tub after each dip.

As most of the recipes are written in their chemical or botanical names, along with technical terms generally used in the dyehouse, I have inserted an alphabetical explanation of them to which you can refer if you are not conversant with the terms used.

BLACK.

Black and brown are the most common colors put upon cotton waste, and there are various methods for coloring them, a few of which are as follows:

Black.

No. 1.	200	pounds	Cotton Waste.
	45	"	Catechu or Cutch.
	25	"	Hematine.
	10	"	Bi-Sulphate Copper.

Shake up the cotton, enter at a boil, and boil one hour. Leave the cotton in the liquor all night; in the morning fish it out and strengthen the liquor with

50	pounds	Hematine.
7	"	Soda-ash.
3	"	Bi-Sulphate Copper.

When these are dissolved, enter the cotton and simmer a short time. Let it remain in all night; in the morning heave

it out and save the liquor for another dyeing. This is to start a new liquor.

Second Dyeing in the same Liquor.

15 pounds Cutch.
7 " Hematine.
3 " Bi-Sulphate Copper.

Enter the cotton as before, boil one hour, leave in all night, then heave out and add to the liquor

25 pounds Hematine.
4 " Soda-ash.
2 " Bi-Sulphate Copper.

Re-enter the cotton as before; let it stay in all night, and proceed in after dyeings with the same amount of cotton and ingredients. The liquor should be of a bluish-red purple when you enter the cotton the second time. The cotton may not be dark enough to suit you on the first kettlefull, but the liquor will improve by age, and will give you colors that will be satisfactory. Wash off the cotton always, and for all colors, after giving them age and air.

BLACK.

No. 2. 225 pounds Cotton.

Tannin Process.

6 pounds Extract Fustic.
25 " Cutch.
5 " Bi-Sulphate Copper.

Dissolve all together. Enter the cotton, boil one hour, leave in all night; in the morning take out, and drain or extract the cotton thoroughly. Save this liquor for further dyeings.

Mordant Process.

8 pounds Bichromate Potash.
8 " Bi-Sulphate Copper.

Enter at a boil heat; let it remain in this mordant two or

three hours. Use the extractor. Shake up the cotton loose in front of the dye tub. Do not boil the cotton in this bath.

Dyeing Process.

30 pounds Hematine.
2 " Extract Fustic.
3 " Bi-Sulphate Copper.

Enter as quick as possible; handle well without boiling; let it stay in until deep enough in shade.

This is the most permanent and softest black that can be colored upon cotton.

For the next kettle of cotton add to the tannin liquor

4 pounds Extract Fustic,
18 " Cutch,
2½ " Bi-Sulphate Copper,

For every 225 pounds of cotton, and proceed with the mordant and dyeing processes as above.

Another Black.

No. 3. 300 pounds Cotton.
80 " Hematine.
12 " Cutch.
24 " Sumach.
18 " Bi-Sulphate Copper.

This is on starting a new liquor. Enter the cotton as above, boil one hour, leave in all night; next day, fish out and add to the solution

20 pounds Hematine.
5 " Soda-ash.
6 " Bi-Sulphate Copper.

Let the cotton remain in this two hours; fish out and enter in a fresh bath of water, in which you will dissolve 6 pounds Bichromate of Potash. Enter at a boil heat; pole up well. Let it remain in this from two to three hours,

For the next 300 pounds of cotton you will reduce the ingredients for the first dip two-thirds, but for the other two dips proceed as for the first 300 pounds.

OLIVE.

In coloring these different shades you will incline them from the pure olive towards the brown, by using more cutch, and towards the green by using more fustic or sumach. For depth and intensity of hue it ranks next to black, and requires a great quantity of dyestuff to color it upon cotton.

Green Olive.

No. 1. 200 pounds Cotton.
50 " Cutch.
60 " Extract Fustic.

Leave the cotton in all night, next morning fish out and drain well. In the mean time add to the liquor

20 pounds Hematine.
10 " Bi-Sulphate Copper.
10 " Soda-ash.

Shake up the cotton, and after the liquor has ceased foaming, enter the cotton quickly at a boil heat; pole well. Boil one-half hour, and let it remain as long as convenient.

For the next 200 pounds of cotton reduce the ingredients in each dip one-fifth, and proceed as before.

Yellow Olive.

No. 2. 200 pounds.

First Dip.

25 pounds Cutch.
10 " Sumach.
4 " Bi-Sulphate Copper.

Second Dip.

5 pounds Bichromate Potash.
3 " Bi-Sulphate Copper.

Third Dip.

15 pounds Extract Fustic.
3 " Hematine.
2 " Bi-Sulphate Copper.

Second Dyeing in the same Liquor.

First Dip.

20 pounds Cutch.
8 " Sumach.
3 " Bi-Sulphate Copper.

Second dip the same as the above, as you will always have this liquor to throw away.

Third Dip.

10 pounds Extract Fustic.
2 " Hematine.
1 pound Bi-Sulphate Copper.

Proceed as with first 200 pounds of cotton.

Olive.

No. 3. 250 pounds Cotton.

Tannin Process, or First Dip.

35 pounds Cutch.
18 " Sumach.
5 " Bi-Sulphate Copper.

Enter and boil one hour; leave in all night; heave out and save the liquor for further use.

Mordant Process.

8 pounds Bichromate Potash.
5 " Bi-Sulphate Copper.

Let it remain in the mordant two or three hours, then proceed as laid down for black, as regards the operations.

Dyeing Process.

15 pounds Hematine.
30 " Extract Fustic.
8 " Bi-Sulphate Copper.

Handle well at a boil heat. Let it remain as long as possible. If you want it of a greener shade, use more blue vitriol in the dyeing process. You can save the dyeing liquor, using but two-thirds of the materials for the next 250 pounds of cotton, and for the next 250 pounds in the tannin process use

25 pounds Cutch.
12 " Sumach.
3 " Bi-Sulphate Copper.

This is the best, although the most laborious and expensive, but it can be relied upon at all times as being permanent.

Another Olive.

225 pounds Cotton.
10 " Sumach.
16 " Extract Fustic.
8 " Hematine.
5 " Bi-Sulphate Copper.

Enter the cotton as before enjoined and leave in all night. Take out and air well, and shake up loosely the cotton; then add to the above liquor or dye tub

2 pounds Hematine.
4 " Soda-ash.
5 " Bi-Sulphate Copper.

Enter the cotton, pole up well and boil a few minutes. Leave in for a few hours.

Second Dyeing in same Liquor, and same amount of Cotton.

8 pounds Sumach.
12 " Extract Fustic,
6 " Hematine.
3 " Bi-Sulphate Copper.

Proceed as above, then add

2 pounds Hematine.
2 " Soda-ash.
3 " Bi-Sulphate Copper.

Proceed in all respects as for the first kettlefull.

BROWN.

This color when it is dyed by the best methods will continually grow richer and deeper the longer it is exposed to the atmosphere, and the process of manufacturing produces beneficial effects upon it, and for these reasons it is one of the best colors that can be made upon cotton to mix with wool.

There are a variety of shades of brown consisting chiefly of three separate or distinct peculiarities; the dark brown, yellow brown and red brown, and the other varieties are obtained by a variation in the quantity of the different materials used for coloring brown.

Brown.

No. 1. 180 pounds Cotton.
100 " Cutch.
65 " Hematine.
10 " Sumach.
6 " Bi-Sulphate Copper.

Let it remain in the kettle all night, in the morning fish out the cotton and keep the liquor for further use, drain the cotton well or extract it, but draining will be sufficient. In another tub of clean water dissolve

6 pounds Bichromate of Potash.

Enter the cotton (after being well shook out,) at a boil heat, let it remain in this two hours, then air well before washing off.

Brown.

No. 2. 200 pounds Cotton.
75 " Cutch.
15 " Hermatine.
6 " Bi-Sulphate Copper.

Second Dip.

6 pounds Bichromate Potash.
5 " Bi-Sulphate Copper.

Proceed in all respects as for No. 1.

For other kettlefulls of cotton reduce the ingredients one-fifth except the chrome baths.

Brown.

No. 3. 225 pounds Cotton.
75 " Cutch.
20 " Sumach.
5 " Bi-Sulphate Copper.

Enter the cotton at a boil and boil until the whole is saturated with the liquor. Let it stay in the kettle all night. Take out in the morning and let it drain well, and then shake up loosely; then dissolve in a bath of clean water

6 pounds Bichromate Potash.
5 " Bi-Sulphate Copper.

Enter at a boil heat, boil one-half hour, leave in two or three hours; air well before washing off.

For the next kettlefull use in the first bath

50 pounds Cutch.
15 " Sumach.
2 " Bi-Sulphate Copper.

Proceed as above.

Second Dip.

6 pounds Chrome.
5 " Blue Vitriol.

Another Brown.

A very good and cheap one.

150 pounds Cotton.
40 " Cutch.
10 " Hematine.
5 " Extract Fustic.
6 " Bi-Sulphate Copper.

Enter and boil one hour; let it remain in the kettle all

night. In the morning take out the cotton, drain well. Add to the liquor

30 pounds Cutch.
7 " Bi-Sulphate Copper.

Re-enter the cotton, boil gently half an hour; let it remain in as long as convenient.

Second Dyeing in the same Liquor.

150 pounds Cotton.
35 " Cutch.
5 " Hematine.
3 " Bi-Sulphate Copper.

Enter the cotton and boil one hour, let it remain in four or five hours, take out and drain as long as time will allow. Add to the liquor

25 pounds Cutch.
8 " Blue Vitriol.

Re-enter the cotton, boil half an hour; let it stay in all night. By this method I have colored a kettlefull a day, by always entering the last time late in the afternoon, and giving it a chance to take up the liquor by letting it stay in all night.

GREEN.

This color is not used alone as a plain color, its best effects will be in mixtures with other colors, as it contrasts well showing a great deal of vivacity and harmony in combination with other colors, it is quite permanent and will stand the scouring and fulling very well, but steaming affects it considerably, in all other respects it is good. If we were coloring deep shades we could use catechu or cutch with the coloring liquor, which would increase its permanency and enable it to withstand the steaming better than it would otherwise do.

Green.

No. 1. 175 pounds Cotton.
7 " Bichromate Potash.
7 " Bi-Sulphate Copper.

Enter cotton at a boil and boil one hour, leave in all night. Finish with

10 pounds Extract Fustic.
8 " Hematine.
6 " Bi-Sulphate Copper.

Enter the cotton at a boil heat, pole up well, boil one-half hour, let it remain in as long as possible or all night.

No. 2. 200 pounds Cotton.

Tannin Process.

20 pounds Cutch.
10 " Sumach.
5 " Bi-Sulphate Copper.

Enter the cotton and boil one hour, leave in all night, take out and save this liquor for other dyeings.

Mordant Process.

8 pounds Bichromate of Potash.
8 " Bi-Sulphate Copper.

Enter cotton at boil heat, pole up well, let it remain in two hours, take out and extract it well.

Dyeing Process.

12 pounds Extract Fustic.
10 " Hematine.
4 " Bi-Sulphate Copper.

Enter as above and let it remain in the liquor all night.

This is the best green that can be colored upon cotton waste.

Another Green.

First Dyeing.

220	pounds	Cotton.
20	"	Sumach.
15	"	Extract Fustic.
10	"	Hematine.
7	"	Bi-Sulphate Copper.

Enter the cotton and boil one hour, let it lay four hours if you can, then take out and add to the liquor

2	pounds	Hematine.
4	"	Extract Fustic.
8	"	Soda Ash.
5	"	Bi-Sulphate Copper.

After these are dissolved and the liquor has ceased foaming, enter the cotton with lively handling, pole up well, and boil fifteen minutes, let it stay in all night.

The subsequent dyeings in the same liquor are as follows:

8	pounds	Hematine.
12	"	Extract Fustic.
6	"	Bi-Sulphate Copper.

Enter the same quantity of cotton and proceed as in first dyeing, then add

2	pounds	Hematine.
4	"	Extract Fustic.
7	"	Soda Ash.
4	"	Bi-Sulphate Copper.

And proceed as directed for the first dyeing.

BLUE.

The deepest and most beautiful shades of color are those that are done by the tannin, mordanting and dyeing process.

es, and are almost equal in appearance to the fullest indigo blue. They resist the operations of manufacturing and the fulling mill remarkably well, losing a little of their bloom only. This triple process or chrome blue is the best in all respects and is the one most particularly recommended, although the others are very good, and being more easily produced, will answer for most purposes.

Blue.

No. 1. 225 pounds Cotton.
8 " Bichromate Potash.
6 " Bi-Sulphate Copper.
4 " Alum.

Enter the cotton and boil one and one-half hours. Leave it in all night; next morning take out and extract it, shake up the cotton well in front of the kettle; then finish off with

100 pounds Logwood (chips).
10 " Hypernic.
2 " Bi-Sulphate Copper.

After boiling the logwood one and one-half hours, take out the bags, dissolve the sulphate, enter the cotton smartly and pole it quickly, and bring it to a boil for half an hour, and leave it in until deep enough for your pattern.

Light Blue.

No. 2. 200 pounds Cotton.
7 " Bichromate Potash.
7 " Bi-Sulphate Copper.
5 " Potash Sulphate Alumina.

Finish with

75 pounds Logwood (chips).
5 " Bi-Sulphate Copper.

Proceed in every respect as with No. 1.

Lavender.

No. 3.	225	pounds	Cotton.
	8	"	Bichromate Potash.
	12	"	Potash Sulphate Alumina.
	6	"	Bi-Sulphate Copper.

Finish with

50	pounds	Logwood (chips).
15	"	Hypernic.
2	"	Bi-Sulphate Copper.

Proceed as for blues. This will need smart handling in order to have it even.

Another Blue.

200	pounds	Cotton.
15	"	Hematine.
8	"	Bi-Sulphate Copper.

Enter the cotton and boil one and one-half hours; pole it well. After remaining as long as time will admit, two or three hours, take the cotton out and let it drain as long as convenient. Strengthen the liquor with

5	pounds	Hematine.
3	"	Extract Hypernic.
7	"	Soda-ash.
5	"	Bi-Sulphate Copper.

After you have dissolved the ash and copper, which must be done separately, and the liquor has ceased foaming, re-enter the cotton and boil half an hour; let it remain in the kettle all night. Take out the cotton and save the liquor for further use. In coloring a second or more kettlesfull, proceed in every respect as above, only reduce the ingredients one-fifth for every 200 pounds or so of cotton.

Another Blue, and the Best One.

230 pounds Cotton.
20 " Cutch.
$2\frac{1}{2}$ " Bi-Sulphate Copper.

Boil the cotton one hour; let it stay in six hours, or all night. Fresh bath of

8 pounds Chrome.
8 " Bi-Sulphate Copper.
4 " Potash Sulphate Alumina.

Boil the cotton half an hour. Let it stay in the liquor all night; in the morning either wash the cotton off or extract it thoroughly. Shake out the cotton well, then finish with

35 pounds Hematine.
5 " Bi-Sulphate Copper.

Enter the cotton rapidly, pole it up well, stop the boil, and let it remain in as long as it takes up color.

I regret that I have not sufficient of cotton that was colored by the above recipe to insert a sample in every volume.

I will here say that wherever the sulphate of copper is used in the dyeing solution, it should not be put in until after the coloring matters are dissolved or boiled out.

YELLOW.

First Dyeing.

210 pounds Cotton.
25 " Extract Fustic.
10 " Bi-Sulphate Copper.

Boil one hour and a half. Leave in all night; in the morning fish out the cotton, wash and dry. Save the liquor, as

you can color in this liquor for an indefinite length of time.

For the second dyeing of the same quantity of cotton use

18 pounds Extract Fustic.
7 " Bi-Sulphate Copper.

Proceed in every respect as for the first dyeing. This is perfectly fast.

Sage.

175 pounds Cotton.
8 " Bichromate Potash.
8 " Bi-Sulphate Copper.

Boil one hour; leave in all night. Drain it or extract it before entering into next solution. Finish with

12 pounds Hematine.
25 " Extract Fustic.

Boil one hour and leave in as long as convenient.

Dark Lavender.

200 pounds Cotton.
10 " Bichromate Potash.
8 " Bi-Sulphate Copper.
10 " Potash Sulphate Alumina.

Boil one hour. Leave in all night; next morning extract or drain the cotton well before entering into the finishing liquor; then boil up

30 pounds Hypernic.
60 " Logwood (chips).
2 " Bi-Sulphate Copper.

Boil the cotton half an hour, and leave in as long as convenient.

MINOR SHADES OF THE POSITIVE COLORS.

It is in these minor colors more than any other that experience and judgment in the dyer are absolutely indispensable. The variety in tone of numerous fancy shades being so great, no recipe can be given to color any particular pattern. The numerous shades are principally due to the diminution of the orignal color to which they belong. Thus all the slates point directly to the black, so do the drabs to the olive, and the fawns to the brown, as the source from which they separately proceed. They represent three separate scales of color, divided into as many parts as there are distinct varieties in their appearances, each variety representing one degree or quantity of color more or less than the one preceding or following it, in an apparently graduating scale. We will, therefore, only give recipes for such particular shades as we have colored and have got samples for, leaving the dyer to determine by his judgment what change in the materials is required to obtain the particular shade he wants.

MINOR SHADES OF BLACKS.

SLATES.

These shades range from the darkest slate to lead.

Dark Slate.

No. 1. 200 pounds Cotton.
56 " Logwood (chips).
13 " Sumach.

Enter the cotton and pole it well, then boil one and a half hours. Let it lay in the liquor as long as you can before saddening; then use in saddening

4 pounds Sulphate Iron.

Dissolve the copperas in some convenient vessel before throwing on the cotton; pole well; do not boil after you sadden. Let the cotton remain in as long as possible.

Slate.

No. 2. 225 pounds Cotton.
12 " Hematine.
10 " Sumach.

Proceed as for No. 1, then sadden with

6 pounds Sulphate Iron.

Boil one-half hour. Leave in as long as possible.

Lead.

No. 3. 175 pounds Cotton.
7 " Cutch.
$1\frac{1}{2}$ " Hematine.
2 " Bi-Sulphate Copper.
4 " Sulphate Iron, (Copperas.)

Boil one hour, leave the cotton in all night.

MINOR SHADES OF OLIVES.

DRABS.

Stone Drab.

No. 1. 225 pounds Cotton.
25 " Cutch.
4 " Hematine.
3 " Bi-Sulphate Copper.

Boil the cotton one hour, and then sadden as for slate by using

4 pounds Sulphate Iron.

Let it stay in all night.

Dark Drab.

No. 2. 210 pounds Cotton.
40 " Cutch.
6 " Hematine.
4 " Extract Fustic.
5 " Bi-Sulphate Copper.

Boil one hour then sadden with

4 pounds Sulphate Iron.

Leave the cotton in all night.

Red Drab.

No. 3. 250 pounds Cotton.
35 " Cutch.
18 " Sumach.
5 " Bi-Sulphate Copper.

Boil the cotton one hour, leave in all night, next morning fish out the cotton, and save this liquor for another 250

pounds of cotton, by adding two-thirds more of the above materials to the liquor. Finish off in fresh bath of

8	pounds	Bichromate Potash.
5	"	Bi-Sulphate Copper.

Pole the cotton up well, do not boil, let it remain in two or three hours.

Silver Drab.

No 4.	225	pounds	Cotton.
	10	"	Cutch.
	1	"	Hematine.
	3	"	Sulphate Iron.
	1	"	Bi-Sulphate Copper.

After these are all dissolved enter the cotton and boil one-half an hour, leave in all night.

All these colors will rise by age and in the operation of fulling and scouring.

Satin, or Pearl Drab.

No. 5.	200	pounds	Cotton.
	4	"	Logwood, (Chips.)
	5	"	Camwood.

Boil one hour, let it remain two hours, then draw off and fill up the kettle again with cold water, let it lay in this all night. When this color is scoured it will be darker and more of a light blue drab color.

MINOR SHADES OF BROWNS.

Red Fawn.

No. 1.	230	pounds	Cotton.
	10	"	Cutch.
	10	"	Camwood.

Boil these ingredients for one hour, then enter the cotton

and boil one hour, then dissolve in a barrel of the dyeing liquor

3 pounds Bi-Sulphate Copper.

Throw on this solution and pole the cotton well for twenty minutes. Let it stay in all night.

Salmon Fawn.

No. 2.	180	pounds	Cotton.
	25	"	Cutch.
	5	"	Extract Fustic.
	5	"	Hematine.
	4	"	Bi-Sulphate Copper.

Proceed as in No. 1, only let it stay in all night before you finish it off; then finish in a fresh bath with

6 pounds Bichromate Potash.

Enter at a boil heat, leave in two or three hours, take out and wash off. You can keep the first liquor for further use by adding two-thirds more of each article for every 180 pounds of cotton, and finish off as for first 180 pounds.

Another Fawn.

200	pounds	Cotton.
25	"	Cutch.
5	"	Bi-Sulphate Copper.

Boil the cotton one hour; let it stay in all night; in the morning take out and drain well, then finish in fresh bath with

5 pounds Bichromate Potash.

Enter at a boil heat, and after laying in this two hours, it is finished. Then wash off the cotton.

Drab Fawn.

No. 3.	200	pounds	Cotton.
	10	"	Sumach.
	35	"	Hematine.
	50	"	Cutch.
	2	"	Blue Vitriol.

Boil the cotton one hour; leave it in all night; next day finish off in a fresh bath of

4	pounds	Chrome.
4	"	Blue Vitriol.

Boil fifteen minutes; draw off, and wash the cotton.

Keep the first liquor, and for the next 200 pounds of cotton add to the first bath

8	pounds	Sumach,
25	"	Hematine,
35	"	Cutch,
2	"	Blue Vitriol,

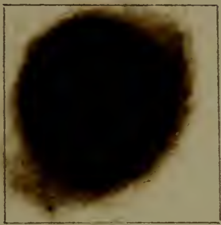
and proceed as above, and in the finish use the same amount of chrome and vitriol.

COTTON.

BLACKS.

No. 1.

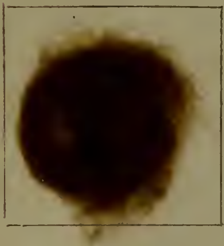
No. 2.



No. 3.

OLIVES.

No. 1.



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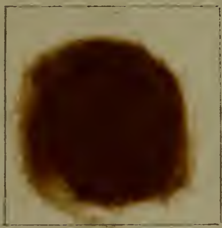


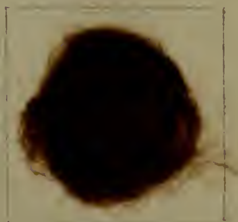
No. 3.

BROWNS.

No. 1.

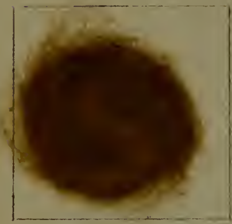
No. 2.

No. 3.



GREENS.

No. 1.



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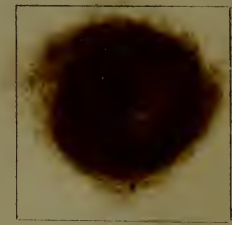
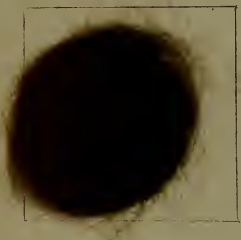


BLUES.

No. 1.

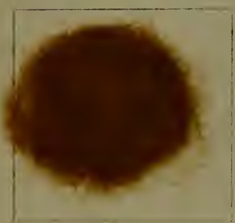


No. 2.

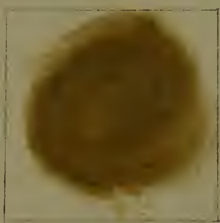
LAVENDER.

No. 3.

YELLOW.



SAGE.



DK. LAVENDER

Minor Shades of Black.

SLATES.

No. 1.

No. 2.

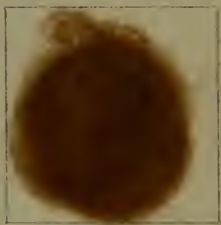
No. 3.

DRABS.

No. 1.

No. 2.

No. 3.



DRABS.

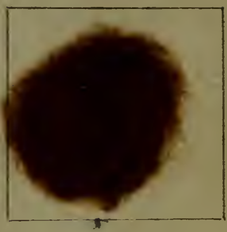
No. 4.

No. 5.

RED FAWN.
No. 1.

SALMON FAWN.
No. 2.

DRAB FAWN.
No. 3.



MISCELLANEOUS RECIPES.

CLOTHS.

These recipes for piece dyeing are splendid colors and I regret that I have not cloth so as to affix samples to them.

Green Olive.

4 pieces Doeskins, weight 165 pounds.

Preparation.

4 pounds Bichromate Potash.
4 " Red Tartar.

Boil one and one-half hours, cool them off, then finish with

45 pounds Fustic.
8 " Madder.
10 " Camwood.
22 " Logwood.

Boil the cloth two hours, then wash off.

Brown.

4 pieces Doeskins, weight 175 pounds.

Preparation.

4 pounds Chrome.
4 " Tartar.

Boil one and one-half hours, then finish with

50 pounds Fustic.
8 " Madder.
25 " Camwood.

Boil cloth two hours, then sadden with

8 pounds Proto-Sulphate of Iron.

And boil one-half an hour, air well and wash off.

Claret.

4 pieces Doeskin Beavers, weight 175 pounds.

Preparation.

4½ pounds Bichromate Potash.
4½ " Red Tartar.

Boil cloths one and one-half hours, then finish with

125 pounds Camwood.
10 " Logwood.
10 " Fustic.

Boil cloths two hours, then sadden with

2½ " Bi-Sulphate Copper.
4 " Proto-Sulphate Iron.

Boil one-half an hour, air and wash off.

Olives.

4 pieces Doeskin Beavers, weight 175 pounds.

Preparation.

4 pounds Chrome.
4 " Red Tartar.

Boil one and one-half hours, then finish with

60 pounds Fustic.
8 " Madder.
30 " Logwood.

Boil two hours, air well, wash off, etc.

Brown Olive.

4 pieces Doeskins, weight 160 pounds.

Preparation.

4 pounds Chrome.
4 " Super-Tartrate Potash.

Boil the cloths one and one-half hours, air well, then finish with

80 pounds Fustic.
10 " Madder.
25 " Hypernic Wood.
10 " Logwood.

Boil two hours, air and wash.

Yellow Olive.

4 pieces Doeskins, weight 160 pounds.

Preparation.

4 pounds Chrome.
4 " Super-Tartrate Potash.

Finish with

100 pounds Fustic.
12 " Madder.
10 " Logwood.

Proceed as with the other olives.

Brown.

4 pieces Doeskins, weight 170 pounds.

Preparation.

4 pounds Chrome.
4 " Red Tartar.

Boil one and one-half hours, air well, then finish with

70 pounds Fustic.
7 " Logwood.
70 " Hypernic Wood.
8 " Madder.

Boil cloths one and one-half hours, then sadden with

3 pounds Bi-Sulphate Copper.

Boil one hour, wash off.

Black.

4 pieces Doeskin Beavers, weight 175 pounds.

Preparation.

18 pounds Fustic.
10 " Logwood.
5 " Copperas.
5 " Blue Vitriol.
5 " Tartar.

Boil out the fustic and logwood before putting in the copperas, etc. Boil the pieces one and one-half hours, take out and air well, then finish off with

45 pounds Logwood.

Boil the pieces one and one-half hours, air them, and spec dye.

Another Black.

100 yards Doeskin, 26 ounces to yd., 162 pounds.

Preparation.

4 pounds Chrome.
3 " Blue Vitriol.
1½ pints Sulphuric Acid.

Boil the cloth one and three-fourths hours, take out, air well, then finish with

60 pounds Logwood.

Boil one hour, take out the cloth, air well, then spec dye.

Blue Black.

The same amount of cloth. Proceed as the above black, only in the finishing use 40 pounds instead of 60 pounds of logwood.

Spec Dye, (cold).

50 pounds Hematine.
50 " Soda-ash.
10 " Bi-Sulphate Copper.

Run the pieces six ends, and for every piece (after the first four pieces) give two quarts of a stock liquor made of the above proportions.

Red Brown.

4 pieces Doeskins, weight 175 pounds.

Preparation.

4 pounds Bichromate Potash.

Boil the cloth one and one-half hours, then finish with

100 pounds Fustic.
70 " Hypernic Wood.
7 " Logwood.
10 " Madder.

Boil the cloth one and one-half hours, then sadden with

2 pounds Blue Vitriol,

and boil one hour.

Olive.

4 pieces Doeskins, weight 180 pounds.

Preparation.

3 pounds Chrome.
3 " Red Tartar.

Boil one and one-half hours, then finish with

90 pounds Fustic.
20 " Logwood.
10 " Hypernic Wood.
10 " Camwood.

Boil the cloth one and one-half hours, then sadden with

1 pound Copperas.
2 pounds Blue Vitriol.

Boil three-fourths of an hour.

Dahlia.

4 pieces Doeskins, weight 170 pounds.

Preparation.

4 pounds Bichromate Potash.
2 " Bi-Sulphate Copper.
1 pound Oxalic Acid.
1½ pints Oil Vitriol.

Boil the cloth one and one-half hours, then finish with

60 pounds Hypernic.
20 " Camwood.
4 " Cudbear.
5 " Logwood.

Boil two hours, air, and wash off.

Another Dahlia.

4 pieces Elastiques, weight 165 pounds.

Preparation.

4 pounds Bichromate Potash.
4 " Super-Tartrate Potash.

Boil one and one-half hours, then finish with

60 pounds Hypernic.
6 " Logwood.
5 " Cudbear.

Boil one and one-half hours, then wash off with fullers' earth.

Blue.

4 pieces Doeskins, weight 170 pounds.

Preparation.

6 pounds Alum.
1 pound Oxalic Acid.
1 " Chrome.

Boil the cloth one and one-half hours, air well, then finish with

30 pounds Logwood.
15 " Hypernic.

Boil the cloth one and one-half hours.

Another Blue, (better than the above.)

Preparation.

5 pounds Alum.
3 " Oxalic Acid.
2 " Chrome.

Boil the cloth one and one-half hours, air well, then finish with

40 pounds Logwood.
5 " Cudbear.

Boil one and three-fourths hours.

Prussian Blue.

2 cuts or 90 pounds Flannels (twilled).
12 pounds Red Prussiate of Potash.
3 pints Oil Vitriol.
3 " Muriatic Acid.
3 " Nitric Acid.

Dissolve the prussiate, then add the acids; the water not to be over 130 degrees Fahrenheit, at which heat enter the flannels, turn on the steam gradually, so as to bring it to a boil in one hour, and boil for fifteen minutes. I have used six pounds of yellow prussiate and the same of red instead of all red, but do not think the color is so good for it. This is the best and most simple way of coloring this blue.

SCARLET.

2 cuts, weight 100 pounds, Flannel, (Twilled).
7½ pounds Cochineal.
½ pound Flavine.
3 pounds Red Tartar.
10 " Nitro-Muriate of Tin.

Enter after boiling these materials ten minutes ; boil the goods one hour, wash off well. This is a beautiful scarlet.

GREEN.

2 cuts or 300 yards, weight 72 pounds, Plain Flannel.
40 pounds Ground Fustic.
6 pints Chymic.
3 pounds Alum.

Boil these materials together for one-half hour before entering the flannel, then boil them for one and one-half hours ; wash off well. The chymic is made with seven pounds of oil vitriol and one of indigo. (See article Sulphate of Indigo, how to proceed in making it.)

ORANGE.

2 cuts, 300 yards, weight 82 pounds, Plain Flannel.
3½ pounds Flavine.
1 pound Cream Tartar.
1 " Alum.
¾ " Cochineal.
12 pounds Muriate of Tin.

Boil these materials for ten minutes before entering the flannel. Boil them three-fourths of an hour ; wash off well.

Another Scarlet.

2 cuts, 300 yards, Heavy Flannel, weight, 120 pounds.

16 pounds	Lac Dye.
½ pound	Flavine.
2½ pounds	Cream Tartar.
3 "	Cochineal.
5 quarts	Nitro-Muriate of Tin.

Proceed as with the orange, and wash off well.

If you wish to color plaid flannels, that is, where those that are woven in black and white checks are to be colored scarlet, green or orange, reduce the materials of the above recipes one-fifth, and proceed as for plain flannel.

REMARKS ON ANILINES AND ANILINE COLORS.

As a general thing, we find that most of the aniline colors are not soluble in water: the blues are the most insoluble, the violets or purples come next; the reds are sufficiently soluble for dyeing in boiling water.

The solvents for most of the aniline colors are alcohol, acetic, sulphuric and tartaric acids. When alcohol is used as the solvent, its proportion we find variable with the kind of dye or substance it has to dissolve. I find that 35 parts of alcohol to 1 of blue, and 25 parts of alcohol to 1 of violet, are good proportions. The iodine blues, where the iodine has been left (in the color), will require a less quantity of alcohol to dissolve them, and the same may be said of the violets.

All aniline colors will precipitate by adding a solution of tannin (sumach or nut-galls) to them, but you can dissolve it again in alcohol, acetic acid, or diluted oil of vitriol.

There have been several methods adopted to do away with alcohol as a solvent, such as decoctions of certain roots, but these methods have not been very successful. Concentrated sulphuric acid, with or without the aid of heat, will dissolve

the aniline blues and violets, and by the addition of a large amount of water, it will be rendered soluble in hot water; but if you should have your oil of vitriol too hot when dissolving the blue aniline, it will impair their fastness. The soluble blues or violets are colors that have been treated with sulphuric acid to make them more soluble, and I warn dyers against them, as we all know that too much solubility is a detriment to dyeing fast colors, but for yarns and flannels it is not so objectionable.

The colors obtained from phenic acid and napthaline are often more soluble than those from aniline.

The impurities in anilines are, as a general thing, sugar, salt, arsenic, resinous and tarry substances. Sugar and salt you will find in the reds and violets mostly. To detect this fraud is simple: "Put a small quantity of the solid dye in a test tube, then add alcohol and shake it well. Let it stand for a few minutes, then pour it off carefully, leaving the residuum. Add some more alcohol, and so repeat the operation until the dye is all dissolved, when the sugar or salt will be found at the bottom of the test tube; those substances not being soluble in alcohol, will of course settle to the bottom."

I never have used any anilines (especially the reds and violets) that did not contain some of the above adulterations in them, except those that were manufactured by Brooke, Simpson & Spiller, at the "Atlas Works," London, England, whose sole agents for the United States are Messrs. Beach & Co., Hartford, Conn. I have often tested their anilines and always found them uniform and unadulterated, free from arsenic or any other injurious substances — so free that they can be employed for coloring confectioneries without the least injury. This cannot be said or claimed by any other aniline manufacturers.

The samples of aniline colors that you will find in this work were colored with the above named anilines, and I pledge myself to produce them with the recipes attached to the samples, and any dyer can do the same by following the directions.

I would advise all dyers that have not tried Brooke, Simpson & Spiller's anilines to do so, and I have no hesitation in asserting that after they have used them once they will use no other aniline dyes but those manufactured by the above firm.

In coloring with other anilines I have often had poor results, especially with the blues and violets, on account of their impurities. Some of the blues I would have to dispense with sulphuric acid and substitute an alkali, in order to produce the right shade.

It is more easy to color with aniline dyes than any other dyes, or at least, as regards animal fibres; nevertheless, certain precautions are necessary.

Wool and silk have such a strong affinity for coal tar colors that they will deprive the bath of its coloring matter so quickly that the wool will be unevenly colored, and the only way to obviate it is to enter the wool expeditiously and pole it until it becomes even; or if you are coloring yarn, you must begin with about one-half of the aniline that you intend to use, then add the other half gradually. As some blues are very soluble, there should not be any acid used in the solution.

The degree of acidity and the temperature of the coloring bath have a great influence upon the shades (of blues especially). Numerous shades can be produced by varying the temperature of the bath. The higher the heat the more blue the shade and the more permanent the color, and the more under the boiling point the redder the shade. The best temperature to commence coloring with is about 130 degrees Fahrenheit, and gradually raise the heat to the boiling point.

With each recipe you will find directions for coloring each color. All the samples of aniline colors in this book will resist the fulling, and are perfectly fast colors.

MISCELLANEOUS RECIPES.

ANILINE COLORS.

Blue.

No. 1.	400	pounds	Third Fleece Wool.
	30	"	Red Prussiate Potash.
	8	"	Sulphuric Acid.
	8	"	Muriatic Acid.
	8	"	Nitric Acid.

Dissolve the prussiate in cold water, then add the acids, do not have the bath over 120 degrees Fahrenheit, when you enter the materials or the wool, (pole the wool all the time while you are coloring,) after you have entered the wool put on the steam by degrees bringing it to a boil in about one hour. Boil twenty minutes, take out and wash off, then in a fresh bath use

2 pounds Hoffman's B. B. B. (Atlas Works Aniline soluble in alcohol.)

Boil one hour.

This blue gives the indigo test.

Another Blue.

400 pounds Fleece.

Color in the blue vat to a middle blue, wash off, then in a fresh bath use two and one-half pounds of the above aniline.

Boil the wool one and one-half hours, this is a blue that is perfectly fast, and gives the indigo test.

Blue Purple.

No. 2. 200 pounds Wool.

Preparation.

20 pounds Alum.
2 quarts Oil Vitriol.

Boil the wool twenty minutes, leave it in all night, finish with
1½ pounds Hoffman's Violet crystals dissolved in one gallon alcohol.

Enter the wool, pole up well and bring to a boil for fifteen or twenty minutes; leave the wool in for a few hours, take out and wash off.

Picric Acid Yellow.

I do not know of any dyer that has or ever dared to color this yellow, therefore I call it a new color, and claim it as my invention.

No. 3. 200 pounds Fourth Fleece.
¾ pound Picric Acid.
1¾ pounds Red Tartar.

Be sure to dissolve the acid before the wool is entered, boil the solution fifteen minutes before entering the wool, pole well up, boil three-quarters of an hour. This color grows brighter by age and is as fast as indigo blue.

Crimson.

No. 4. 200 pounds Wool.
½ pound Picric Acid.
¼ " Ammonia.

Dissolve the two articles together, then pour them into the kettle. Then dissolve
1½ pounds Roseine, (or Fuschine.)
½ pound Ammonia, together.

When thoroughly dissolved pour it into the kettle with the acid and ammonia, pole well up and boil for half an hour, then wash off.

This crimson I claim as being my invention also, but it

could be improved by using "aniline crimson," instead of Roseine or Fuschine. This color will stand the fulling and scouring better than scarlet.

Dark Magenta.

No. 5. 250 pounds Wool.
2 " Rose Aniline.
2 pailsfull of Fulling Soap.

Boil the solution fifteen minutes before entering the wool, boil the wool one hour.

Magenta.

No. 6. 200 pounds Wool.
1½ " Rose Aniline, (soluble in water,)

Boil the wool one hour.

Aniline Purple.

No. 7. 80 pounds Wool.
6 ounces Hoffman's B. B. B. (Parme).

Dissolve in
2 quarts alcohol.
Then add 2 " Sulphuric Acid.

Enter the wool at about 160 degrees Fahrenheit, and work up to a boil, which continue for about twenty minutes, take out and wash off well.

Nicholson Blue.

No. 8. 175 pounds Fourth Fleece.
1 " Nicholson Blue, B. B. B. (Atlas Works.)

Enter at 130 degrees Fahrenheit, bring up to a gentle boil for thirty minutes, leave the wool in as long as possible, take out and extract it. Finish with
6 quarts Sulphuric Acid,

Or enough acid to have the bath stand 2 degrees Twaddle, enter the wool at 130 degrees Fahrenheit, bring up to a gentle boil which continue for ten or fifteen minutes, take

out and wash off. This blue sample has been scoured; if the sal-soda is used instead of soda-ash in the fulling and scouring soaps it will stand without having to be developed again after the scouring process.

Eclipse Violet.

No. 9. 200 pounds Wool.

Dissolve $1\frac{1}{2}$ pounds eclipse violet aniline in 4 or 5 gallons of water (boiling), stir until all is dissolved, then turn about one-half of the dissolved aniline into the tub or kettle; enter the wool at 140 degrees Fahrenheit, bring up to a boil, which continue for one-half hour, then draw off, air the wool well. Then in a fresh bath add the rest of the dissolved aniline, enter the wool as for first dyeing and boil one hour; leave the wool in all night. If you wish to have a bluer shade than the sample, add one pint of acetic acid in the last dip.

No. 10. 250 pounds Third Fleece.
1 pound Hoffman's B. B. (cake, soluble in water.)
$\frac{1}{4}$ pound Potash Sulphate Alumina.
$\frac{1}{4}$ " Acetate of Lead (white).

Dissolve the lead and alum together in a pail; (be sure that it is all dissolved.) Dissolve the cake and pour into the dye-tub, stir it up well, then pour the dissolved lead and alum into the tub and stir it up. Now enter the wool at 160 degrees Fahrenheit; pole the wool until it boils, and boil it for half an hour. Let it remain in the dye as long as convenient, take out and wash off.

Dark Magenta.

150 pounds Woolen Yarn.

Preparation.

1 pound Bichromate Potash.

Boil one hour. Keep turning the yarn during the time of boiling; then wring out and finish with

7 pounds Cudbear.
1 pound Fuschine.

Boil one-half hour. Handle the yarn as above.

Another.

Same amount of yarn and the same preparation; handle the same, and finish with

7 pounds Cudbear.
5 " Camwood.
¾ pound Fuschine.

Proceed in all respects as for the other magenta.

Prussian Blue.

300 yards of 4 ounce per yard Flannel.
10 pounds Red Prussiate of Potash.
4 " Sulphuric Acid.

Enter the flannel at 160 degrees Fahrenheit, heat up gradually to 200 degrees, but no higher. The flannels should be a good green after they have been in for half an hour, if not, run them until they are; then take out and rinse off. Fold them up until the next day, then finish with (in a fresh bath)

5 pounds Sulphuric Acid.
2½ " Crystals of Tin.

Enter at 160 degrees, bring up to a boil, and continue for half an hour; wash off.

Prussian Blue.

300 yards Flannel, 4 ounces per yard.
8 pounds Alum.
5 " Red Tartar.
6 ounces Sulphuric Acid.
2½ pounds Indigo Paste.
12 ounces Violet Aniline.

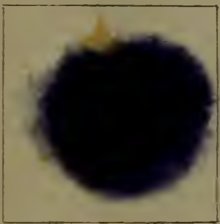
Boil the whole together for fifteen minutes, cool down the solution, enter the flannel and boil three-fourths of an hour.

ANILINES.

ALL THESE SAMPLES WILL RESIST THE FULLING AND SCOURING PROCESSES.

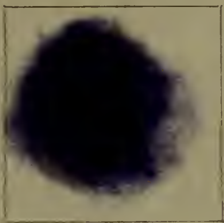
No. 1.

BLUE.



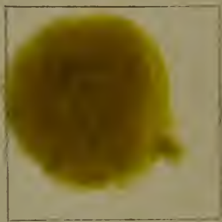
No. 2.

BLUE PURPLE.



No. 3.

PICRIC ACID YELLOW.



No. 4.

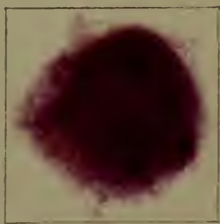
CRIMSON.

No. 5.

DARK MAGENTA.

No. 6.

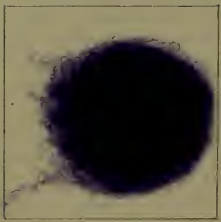
MAGENTA.



ANILINES.

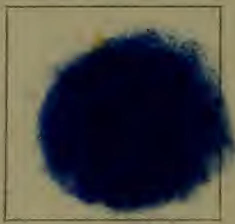
No. 7.

PURPLE.



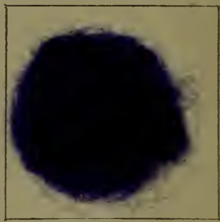
No. 8.

NICHOLSON BLUE.



No. 9.

ECLIPSE VIOLET.



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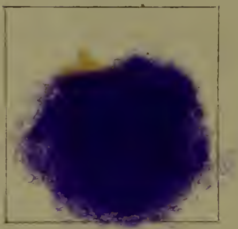

COTTON YARNS.

Scarlet.

20 pounds Yarns.

Steep the yarn in

4 pounds Sumach

Over night, then spirit with muriate of tin, at two degrees Twaddle. Finish off with

2 pounds Peachwood.
3 " Quercitron Bark.

Have the baths luke warm and give nine turns in each bath, wash off. If yellower shades are wanted, use less of the peachwood and more of the bark according to shade wanted.

Fast Blue.

20 pounds Yarn.
1 pound Sulphate Iron.
1½ pints Muriatic Acid.

Give five turns and wring out.

Second Tub.

½ pound Red Prussiate Potash.

Give five turns, take up and add

3 pints Oil Vitriol.

Give five turns, then wash off. These dyes are to be cold ones.

Bright Royal Blue.

First Tub.

20 pounds Yarn.
3 pints Nitrate Iron.

Give six turns.

Second Tub.

3 pounds Yellow Prussiate Potash.
1 gill Sulphuric Acid.

Give six turns, then to the first tub add to the iron liquor in it

1 pound Crystals of Tin.

Pass through the first tub four times, and through the second tub three times, giving six turns each time, wash off.

Boil the yarns (the day before you color them,) two hours in clear water.

Light Olives.

20 pounds Yarn.

To a tub of cold water add the strength of

5 pounds Fustic.
1½ " Logwood,

previously boiled out, give ten turns, lift the yarn out and add

½ pound Sulphate Copper.

Give ten turns, then wash off.

Light Green.

20 pounds Yarn.

To a tub of water at 100 degrees Fahrenheit, add

½ pound Turmeric,

previously boiled out, give ten turns, then lift up and add

4 pounds Alum.
1 " Sulphate of Indigo.

Give ten turns and wash off.

A Full Yellow Drab.

20 pounds Yarn.

To a tub of water at 100 degrees Fahrenheit, add the strength of

½ pound Turmeric.
¼ " Logwood.
8 pounds Fustic.

Give ten turns, then sadden with

2½ pounds Alum.

Give ten turns, and wash off.

Fast Green.

20 pounds Yarn.

Color in the copperas vat to a middle blue, then in a tub of cold water dissolve

1 pound Acetate of Lead.

Give five turns. In another tub of hot water dissolve

1 pound Chrome.

Give five turns and repeat twice, then finish off in the lead liquor with five turns, wash off well.

Brown.

20 pounds Yarn.
2 " Catechu.
¼ pound Blue Vitriol.

Give the yarn eight turns, then wring out.

Second Bath.

½ pound Bichromate Potash.

Give eight turns, at a boil, wring out and wash.

If you wish a yellower shade, use a small quantity of fustic with the catechu.

Silver Drab.

20 pounds Yarn.
¼ pound Logwood.
1 quart Lime Water.

The lime water is made as follows:

1 pound Lime to eight gallons of water, stir up, then let it settle and take the clear liquor, give eight turns and wash off. This is to be a cold dye.

Chrome Yellow.

20 pounds Yarn.

First Tub.

½ pound Acetate of Lead.

Give five turns in this, then in second tub use

½ pound Chrome.

Give five turns and wring out the yarn; then enter again in first tub, give five turns, and wash off well.

Barwood Red.

20 pounds Yarn.

To a tub of cold water add

5 pounds Sumach

previously boiled out; steep the yarn in this all night.

Second Tub of cold water.

Add spirits until it stands at 3 degrees Twaddle; give eight turns, then wash off in cold water.

Third Tub.

Boil up 20 pounds barwood, cool down the liquor a little, enter the yarn and bring up to a spring boil, and turn until you get the shade, say about one hour.

Turkey Red.

This color is dyed the same as barwood red, except after it has boiled one hour, take up the yarn and add one and one-half gills of sulphuric acid; turn, and boil it fifteen minutes longer.

To make Spirits for Cotton Yarn.

1 pound Nitric Acid.
5 pounds Muriatic Acid.

Kill with 2½ ounces of tin to the pound of acids.

Another Way.

1 pound Nitric Acid.
6 pounds Muriatic Acid.

Killed with 2 ounces of tin to the pound of acids.

Mordants for Coloring Aniline Colors on Cotton Thread.

1 pound	Muriatic Acid.
½ "	Nitric Acid.
½ pint	Sulphuric Acid.
½ "	Water.
2 pounds	Grain Tin.

Feather it, then add it by degrees until it is all taken up, when it will be ready for use. To use the mordant, first sumach the thread, then use one pint of the mordant to ten pounds of thread, in water at 100 degrees Fahrenheit; give ten turns and wash off.

Magenta.

15 pounds Thread.

Use mordant for thread, then dye in neutral bath of

2 ounces Golden Roseine, (Brooke, Simpson & Spiller's).

Commence at 140 degrees Fahrenheit, and bring to a spring boil, which continue for fifteen minutes, turning the thread all the time.

Scarlet.

20 pounds Thread.

Prepare as for magenta, then dissolve 3 ounces of the scarlet aniline in a pint of alcohol (90 per cent.); boil for fifteen minutes, or till all the aniline is in solution, work the thread at near the boiling point, say 200 degrees Fahrenheit, until you get the shade required; wash off in cold water.

China Blue.

20 pounds Thread.

Prepare as above. Dissolve 4 ounces of China blue in hot water until all is dissolved, then add one gill of sulphuric acid to the dye; enter the thread at 120 degrees, and bring up to a spring boil for one-half hour.

Eclipse Violet.

25 pounds Thread.

Use cotton mordant as directed, then dissolve

4 ounces Eclipse Violet in hot water, then add
1 ounce Sulphate of Soda.

Work the thread just below the boil for three-fourths of an hour.

Hoffman's Violet.

25 pounds Thread.

Proceed as with the Eclipse Violet, only using Hoffman's Violet Crystals.

Spiller's Purple.

20 pounds Thread.

Use the mordant as for other colors, then dissolve 4 ounces Spiller's Purple in hot water to which add 2 ounces Acetic Acid, (liquid,) enter at 130 degrees Fahrenheit, dye up to the boiling point for one hour.

Green.

25 pounds Thread.

Use the mordant as for other colors.

5 ounces Iodine Green Crystals dissolved in warm water, add

1 ounce Acetic Acid.

Then enter the thread at 125 degrees Fahrenheit, and work slowly up to 190 degrees for three-fourths of an hour, wash off well in cold water.

Bismarck Brown.

20 pounds Thread.

Use the mordant as above, dissolve

5 ounces Naphthaline Brown,

in boiling water, until all is in solution, then enter at 130 degrees Fahrenheit, and work up to 195 degrees; let the time from entering to bringing up to 195 degrees be about one hour.

Glossary of Technical Terms and Chemical Names

USED IN THIS WORK.

Alkalies—(fixed,) Soda, Pot and Pearlash.

Alkalies—(Volatile,) Ammonia.

Alkalies—(Compounds,) Urine and Soap.

Ammonia—See ammonia in Part First.

Azote—Nitrogen.

Argols—Bi-Tartrate of Potash, formed by deposits in wine casks.

Aqueous Tincture—Watery solutions of any solid substance.

Acidulous Salts—All salts that contain an acid.

Alumina—A clay that will combine with acids, forming salts such as Sulphate of Alumina, and Alum.

Acetate of Copper—Verdigris, Acetate of Lead and Blue Vitriol.

Acetic Acid—Vinegar.

Bi-Sulphate of Copper—Blue Vitriol, Blue Stone.

Bichromate of Potash—Red Chromate of Potash, chrome.

Bois Rouge—Camwood.

Borate of Soda—Borax.

Bi-Chloride of Tin.—Double Muriate of Tin.

Bi-Sulphuret of Iron—Iron pyrites.

Crystals of Tin—Salts of Tin, Muriate of Tin crystallized.

Calcium—Lime.

Carbonate of Soda—Crystallized Soda.

Carbonate of Lime—Limestone, Whiting.

Chloride of Calcium—Lime and Muriatic Acid.

Chloride of Tin—Muriate of Tin.

Citric Acid—Lemon Juice.

Chemical Salts—Acids united to any of the earthy, alkaline, or metallic bases; any crystallized body capable of solution.

Doctored—To adulterate, generally applied to such dyestuffs as are not good.

Extract of Fustic—Morin, the solid coloring matter of Fustic.

Extract of Logwood—Hematine, the solid coloring matter of Logwood.

Extract of Indigo—(See Sulphate of Indigo.)

Epsom Salts—Sulphate of Magnesia.

Flurry of a Vat—The froth of oxidized indigo floating on the vat.

Glauber Salts—Sulphate of Soda.

Green Vitriol—Copperas.

Hematine—Extract of Logwood.

Hematoxylon Campechicum—Logwood.

Hartshorn—The volatile alkali, ammonia.

Iodide Potassium—Iodine and Potash.

Killing—Dissolve a metal in an acid, as tin in Muriatic Acid.

Muriate of Tin—Muriatic Acid killed with Tin.

Murio-Sulphate of Tin—Muriatic and Sulphuric Acid killed with Tin.

Muriate of Soda—Common Salt.

Muriate of Sodium—Common Salt.

Mordant—Any one, or the mixture of several of the chemical salts used in dyeing, is the mordant or base of the color; can be applied before or at the same time, or after the coloring matter has been boiled on; in the latter case it is called saddening.

Marine Acid—Hydro-chloric, or Muriatic Acid.

Nitro-Muriate of Tin—Nitric and Muriatic Acids killed with Tin.

Nitrate of Iron—Iron killed with Nitric Acid.

Nitrate of Copper—Copper killed with Nitric Acid.

Nitrate of Soda—Nitric Acid added to common Soda.

Potash Sulphate of Alumina—Alum.

Proto-Sulphate of Iron—Copperas.

Phenic Acid—(Carbolic Acid) an acid found in coal tar.

Persalts of Mercury—Red Oxide of Mercury, (red precipitate) dissolved in Sulphuric Acid.

Pailfulls—A common water pail containing as much as can be put into it.

Protoxide of Tin—A precipitate formed from a solution of crystals of tin by carbonate of soda.

Peroxide of Tin—The ores of tin. *tinstone.*

Red Tartar—See *Argols.*

Sulphate of Iron—Copperas.

Super-tartrate of Potash—Cream of tartar.

Sulpho-muriate of Tin—Sulphuric and muriatic acid killed with tin. See *Solutions of Tin.*

Sulphate of Indigo—Chemic, indigo paste, extract of indigo. See *Sulphate of Indigo.*

Sulphuric Acid—Oil of vitriol.

Soda-ash—A crude, caustic alkali.

Santaline—Red sanders.

Sal-soda—Crystallized carbonate of soda.

Sadden—Giving the mordant after the coloring matter is boiled on the wool or goods.

Salts of Lead—Brown and white sugar of lead.

Salts of Tin—Crystals of tin.

Saddening—Making a color darker by means of a chemical salt. such as copperas, blue vitriol, alum, etc.

Sulphate of Magnesia—Epsom salts.

Sal-ammoniac—Crystallized ammonia, hydro-chlorate of ammonia.

Sulphate of Lime—An insoluble substance, or nearly so, formed of carbonic acid and lime. It is found in small quantities in spring waters.

Sulphate of Soda—Glauber salts.

Sulphate of Copper—Blue vitriol.

Spirits—The different solutions of tin.

Spirits of Salt, (erroneously called so)—Muriatic acid.

Salts of Alumina—Alum.

Tannin—A vegetable principle contained in a variety of substances, such as catechu, cutch, sumach, nut-galls, barks, etc. It is sometimes called the astringent principle.

Tartar—See *Argols.*

Volatile Alkali—Ammonia, hartshorn.

Vegetable Alkali—Potash.

Ware—Hydrate of lime, slacked lime.

For further explanations of substances mentioned in this work the reader must consult chemical works, as it belongs to that science to give a minute description of them, rather than to a work on dyeing; and it is expected that any person professing to be a dyer will be acquainted enough with the nature of chemical subjects, so as to render a minute description of each separate substance unnecessary.

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PART FIRST.

PART SECOND.

PART THIRD.